OPERATOR'S
INSTRUCTION
BOOK

Cincinnati
10" PLAIN HYDRAULIC GRINDING MACHINE

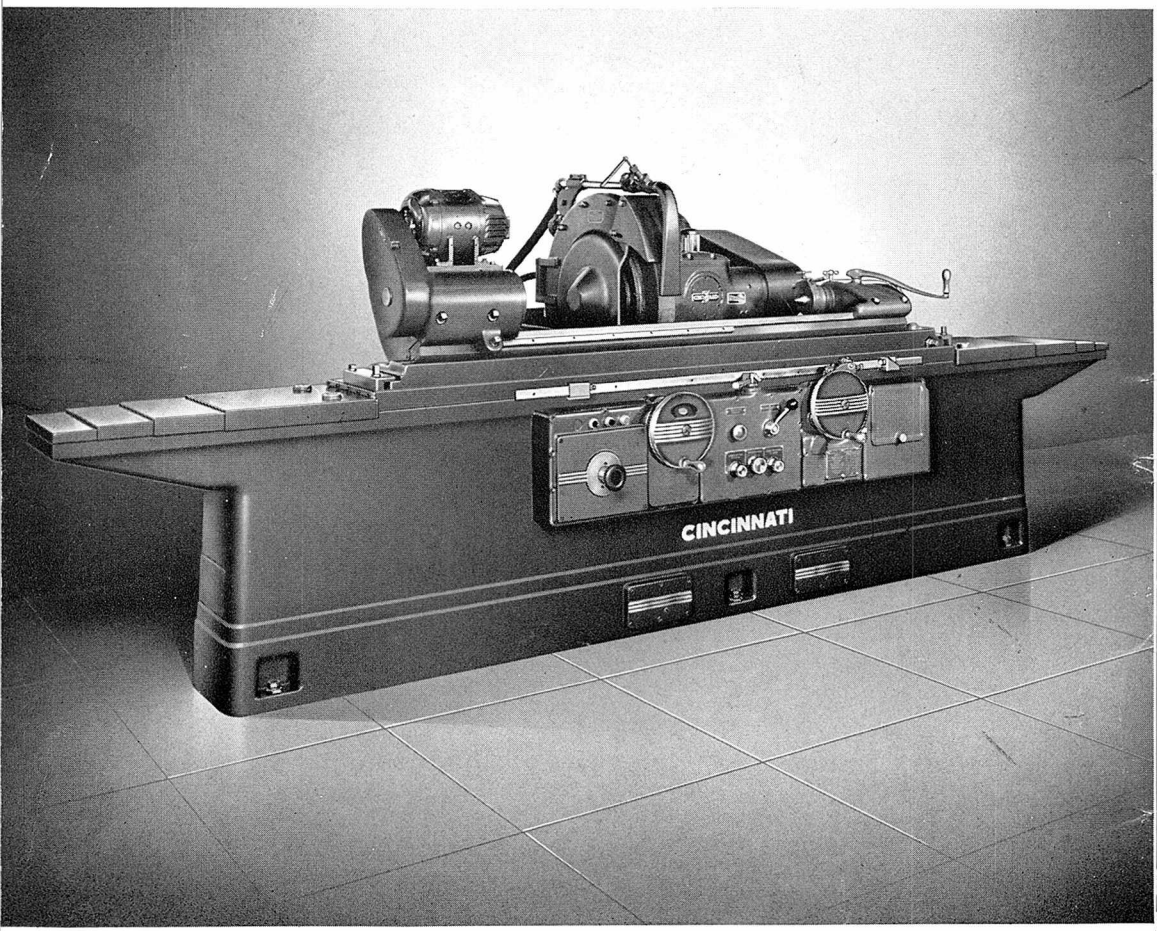
This Booklet should be
Filed in the Tool Crib and
Issued by Tool Check only

CINCINNATI GRINDERS INCORPORATED
CINCINNATI, OHIO, U. S. A.

THIS book was written for the purpose of instructing the operator of a CINCINNATI 10″ Plain Hydraulic Grinding Machine (Model ER) in the proper care and operation of his machine.

At the time of writing, the book was completely up-to-date. However, due to continual improvements in design, it is possible that descriptions contained herein may vary to a slight extent from the machine delivered to you. This would imply nothing more than the fact that the machine has been improved to better fulfill your requirements.

CINCINNATI GRINDERS INCORPORATED
CINCINNATI 9, OHIO, U. S. A.



Front View of the CINCINNATI
10″ x 72″ Plain Hydraulic Grinding Machine
(Model ER)

PATENT NOTICE

The machines and attachments illustrated and described in this book are manufactured under and protected by issued and pending United States and Foreign patents.

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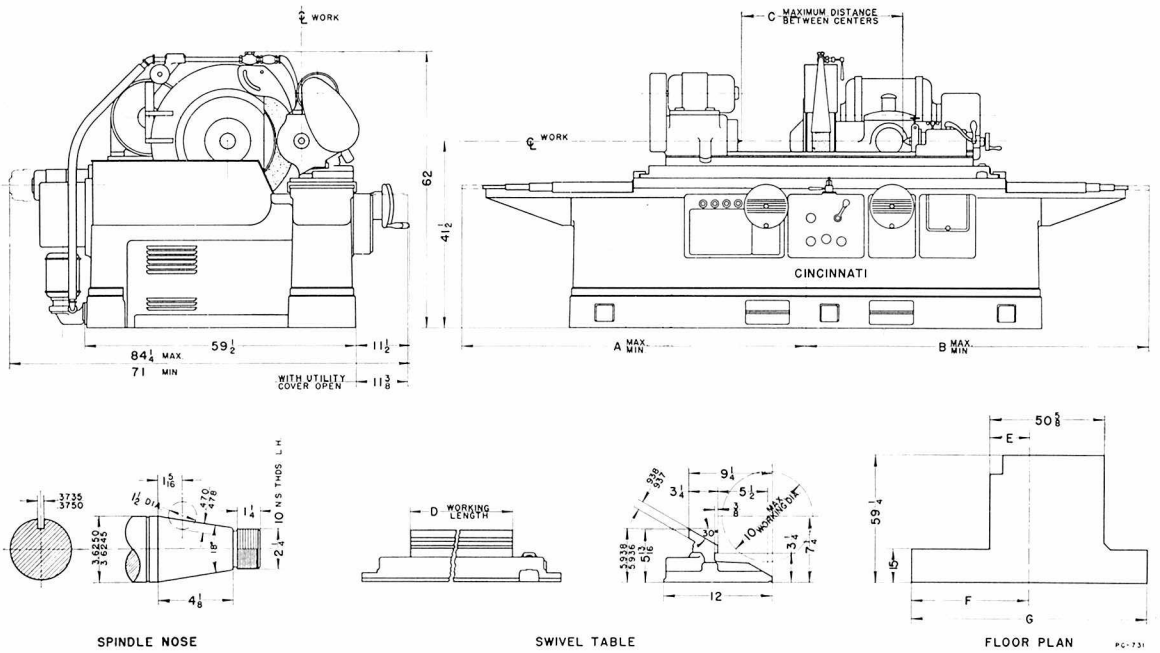

Size of Machine	A		B		C	D	E	F	G
	Max.	Min.	Max.	Min.					
10" x 18"	62½	43½	49½	44¼	19 5/16	53 7/8	20 7/8	36 5/8	73¼
10" x 36"	77⅛	71	77⅛	71	37 5/16	68 3/8	17 3/8	52⅛	104¼
10" x 48"	92⅛	83	92⅛	83	49 5/16	80 3/8	17 3/8	64⅛	128¼
10" x 72"	118 7/8	111 7/8	118 7/8	111 7/8	73 5/16	104 3/8	17 3/8	88⅛	176¼
10" x 96"	144 7/8	137¼	144 7/8	137¼	97 5/16	128 3/8	17 3/8	112⅛	224¼

Figure 1—Dimensional Drawing

PRINCIPAL MACHINE SPECIFICATIONS
10″ Plain Hydraulic Grinding Machine (Model ER)

	10″ x 18″	10″ x 36″	10″ x 48″	10″ x 72″	10″ x 96″
Capacity					
Maximum swing over table	10 15/16″	10 15/16″	10 15/16″	10 15/16″	10 15/16″
Nominal distance between centers	18″	36″	48″	72″	96″
Swivel table graduated to angle of:					
Towards Wheelhead	12°	8 1/2°	7°	6 1/2°	6°
Away From Wheelhead	5°	3°	2°	2°	2°
Swivel table graduated to taper per foot:					
Towards Wheelhead	5″	3 1/2″	3″	2 3/4″	2 3/4″
Away From Wheelhead	2″	1″	1″	1″	1″
Headstock and Footstock					
Taper hole in headstock and footstock spindles, B. & S.	No. 12	No. 12	No. 12	No. 12	No. 12
Number of work rotation speeds	Infinite	Infinite	Infinite	Infinite	Infinite
Range of work rotation speeds: Optional R. P. M.	76 to 292 62 to 237 46 to 172 *25 to 300	76 to 292 62 to 237 46 to 172 *25 to 300	76 to 292 62 to 237 46 to 172 *25 to 300	76 to 292 62 to 237 46 to 172 *25 to 300	76 to 292 62 to 237 46 to 172 *25 to 300
Miscellaneous					
Number of table traverse rates	Infinite	Infinite	Infinite	Infinite	Infinite
Range of table traverse rates (inches per minute)	3 to 220	3 to 220	3 to 220	3 to 220	3 to 220
Minimum movement necessary to reverse table	3/32″	3/32″	3/32″	3/32″	3/32″
Table tarry adjustment	0–5 sec.	0–5 sec.	0–5 sec.	0–5 sec.	0–5 sec.
Grinding wheels regularly supplied (dia. x face x hole)	30″ x 3″ x 20″	30″ x 3″ x 20″	30″ x 3″ x 20″	30″ x 3″ x 20″	30″ x 3″ x 20″
Power Requirements					
Wheelhead motor H. P.	15	15	15	15	15
Hydraulic pump motor H. P.	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2
Headstock motor H. P.	3/4 or 1	3/4 or 1	3/4 or 1	3/4 or 1	3/4 or 1
Spindle lubricating motor H. P.	1/3	1/3	1/3	1/3	1/3
Coolant pump motor H. P.	1/4	1/4	1/4	1/4	1/4
Floor Space Required	84″ x 112″	84″ x 155″	84″ x 185″	84″ x 238″	84″ x 290″
Net Weight	8,600 Lbs.	9,930 Lbs.	10,800 Lbs.	12,600 Lbs.	14,400 Lbs.

*Variable voltage headstock drive.

The design and specifications of the machines illustrated and described herein are subject to change without notice.

STANDARD EQUIPMENT SUPPLIED WITH THE MACHINE
10″ Plain Hydraulic Grinding Machine
(Model ER)

Headstock—Dead spindle, arranged for motor drive but not including motor and controls.

Footstock—Combination screw and lever type, with diamond holder bracket and diamond holder, but without diamond or nib.

Work Driving Dogs—Reversible type, one ¼″ to 2½″ and one 2½″ to 4″.

Grinding Wheels—Two, 30″ diameter x 3″ face x 20″ hole.

Wheel Mount—Balancing type, for 30″ diameter x 3″ face x 20″ hole grinding wheels.

Wheel Guard—For 30″ diameter x 3″ face x 20″ hole grinding wheels, including coolant piping and nozzle.

Pump, Coolant—Individually motor driven, including ¼ H. P. motor, magnetic starter, wiring and complete piping.

One Extra Sheave—For grinding wheel spindle, to provide additional grinding wheel speed (includes safety mechanism).

Headstock Center and Footstock Center.

Splash Guards—Wrenches—Wheel Lifter.

Grinding Wheel Spindle Oil Pump Motor.

See Page 52 for "Extra Equipment"
Not included with Standard (Basic) Machine

INSTALLATION INSTRUCTIONS

Lifting the Machine. Any of the machines except the 10″ x 96″ may be lifted by crane with a three-point hook-up. The hook which is bolted to the front of the bed near the left end of the machine provides one of the lifting points. One and one-quarter inch eye bolts screwed into the tapped holes, one at the left rear corner of the bed and the other in the right table section of the bed directly behind the table, provide the other two lifting points (Figure 2).

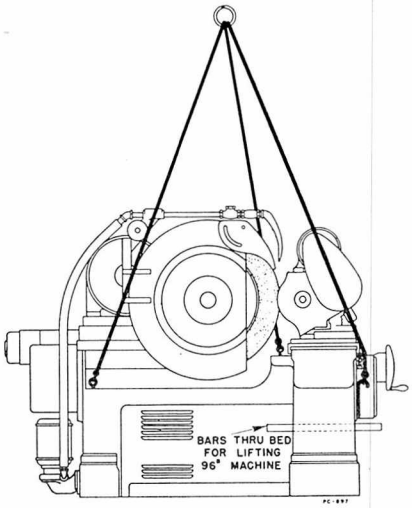

Figure 2
Lifting the Machine

If it becomes necessary to lift the 10″ x 18″ or 10″ x 36″ machine at any time after the original installation, a new lifting point must be used to replace that provided by the hook, which has been returned to our plant. This new lifting point is made available by removing the cover from the left end of the bed and hooking into the hole in the bed at that point. The 10″ x 48″ and 10″ x 72″ machines should be lifted in the same manner as was used in the original hookup. However, it will be necessary to provide a hook similar to the one returned to our plant.

To lift the 10″ x 96″ machine, insert steel bars through each of the two sets of hand holes near the right and left end of the table section of the bed. These bars should be long enough to extend at least 10″ out from the front and rear of the bed. Screw a one and one-quarter inch eye bolt in the tapped hole in the left rear corner of the bed. Then attach the chains or cables over these five lifting points.

Be sure to protect the table and telescoping table way guards, as well as the finished surfaces of the machine, by using wood blocks as indicated in Figure 2.

Location of Machine. When selecting the location for this machine, be certain that the sun's rays will not fall upon parts of the machine, especially the bed, nor will the machine be near any heating appliance. Either or both of the above conditions may cause localized heating and subsequent distortion, which will result in less accurate grinding.

Foundation. To maintain the accurate alignment that has been built into these machines, they must be placed on stable foundations. The 24″, 36″, and 48″ machines will require no special foundation if the floor is constructed of good, reinforced concrete, 8 inches or more in thickness. For floors of lesser stability and strength, a foundation should be built up equal to or better than this foundation specification. Whenever possible, the machine should be installed on a floor which is supported by solid earth. The foundation should not be affected by vibrations generated by nearby machines or any other source. *This requirement is necessary to obtain the best grade of finish.*

The 72″ and 96″ machines may be placed on a foundation similar to that recommended for the shorter machines if the work to be ground does not require close limits of accuracy. However, if the machine is to be used for roll grinding or any other work which requires extreme accuracy and fine finish, it should be provided with a specially constructed foundation of reinforced concrete. This foundation should be constructed in accordance with the foundation plan blue print which is shipped with the machine.

Leveling Instructions. To re-establish perfect alignments, the machine must be accurately leveled. Select a sensitive, graduated tube spirit level, reading to ten seconds per graduation (.0006″ per foot) and provided with screw adjustment. Accuracy of the level depends upon the glass tube and not upon the length of the frame. A short level having a long tube is best. Do not use a carpenter's level or the level in a machinist's combination square as they are not accurate enough.

The following instructions are applicable to all lengths of machines except the 96", for which separate leveling instructions are given on pages 14 and 15.

18", 36", 48" and 72" Length Machines

1. Detach the telescoping table way guards from both ends of the table, exposing the table ways and top finished surfaces of the bed. The telescoping guards are detached by removing the hexagon socket head screws which hold them to the ends of the sliding table.

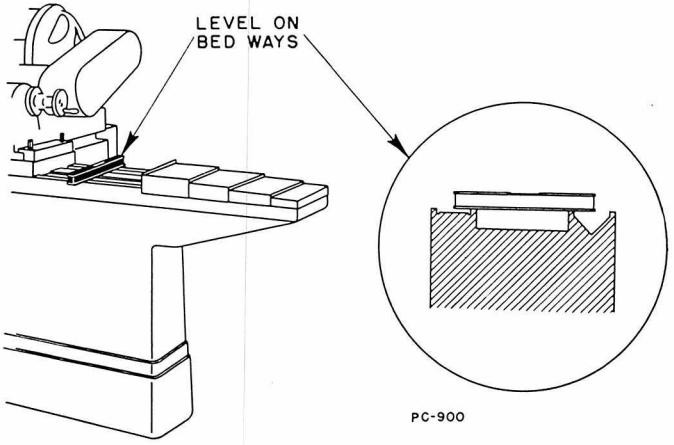

Figure 3
Leveling Instrument on Bed Ways

2. Place the leveling instrument on the top finished surfaces of the bed (Figure 3). Be sure that the top finished surfaces of the bed and the leveling instrument are perfectly clean before starting the leveling operation.

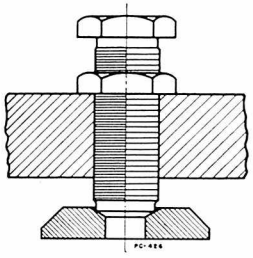

Figure 4
Leveling Jack. Washers under the screw are supplied with the machine

3. Adjust the leveling screws indicated by the letter "A" at the front and rear of the bed (Figures 5 to 8). Adjust these screws slowly and evenly until the leveling instrument indicates absolutely level both lengthwise and across at both ends of the bed.

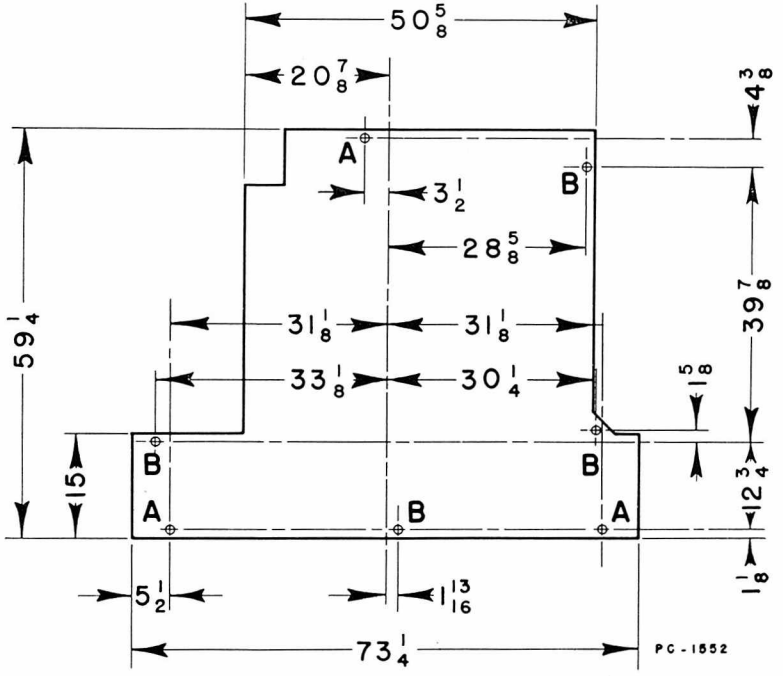

Figure 5
Location of Leveling Screws
10″ x 18″ Machine

4. Adjust the remaining leveling screws, indicated by the letter "B", just enough to solidly contact the floor and prevent the machine from sagging. There are four leveling screws represented by the letter "B" for the 18″ machine, six for the 36″ machine, six for the 48″ machine and ten for the 72″ machine.

5. Re-check for level at both ends of the bed and re-adjust the leveling screws if necessary. Then lock all of the leveling screws in position. Check the machine frequently for accuracy of level.

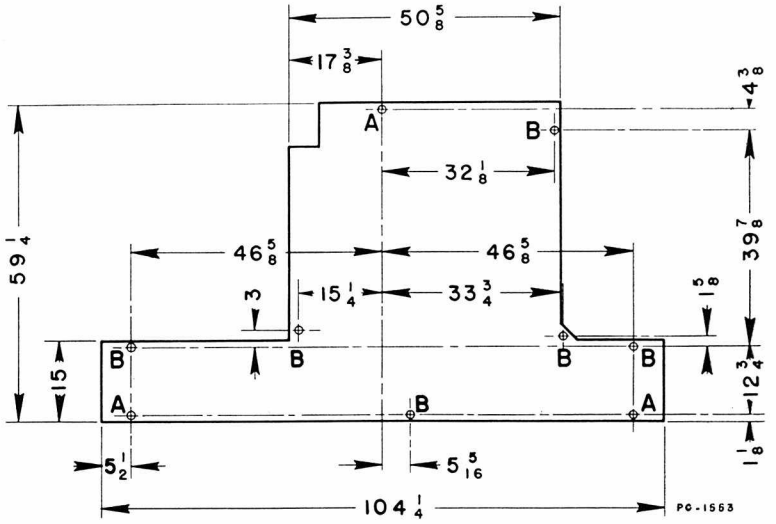

Figure 6
Location of Leveling Screws
10″ x 36″ Machine

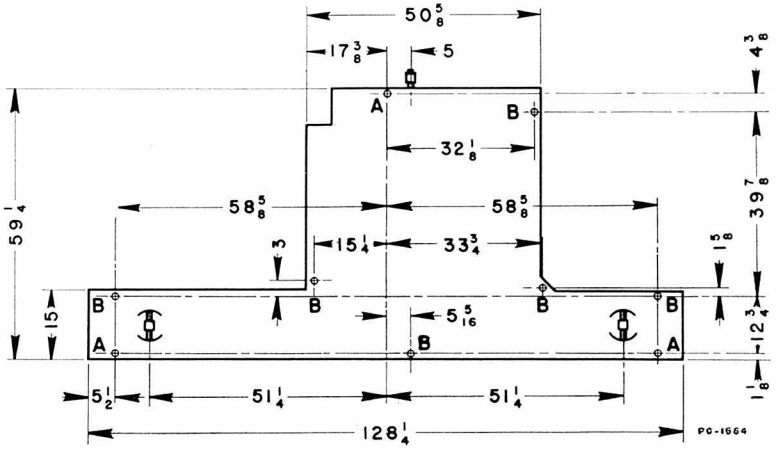

Figure 7
Location of Leveling and Aligning Screws
10″ x 48″ Machine

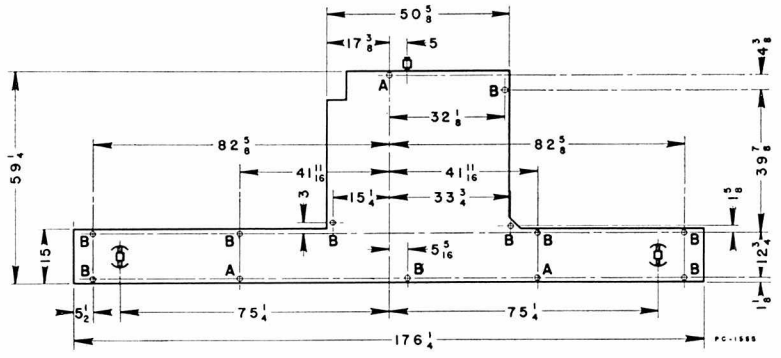

Figure 8
Location of Leveling and Aligning Screws
10" x 72" Machine (Also see Figure 10)

96" Length Machines

The 96" machine is leveled in a slightly different manner than the shorter machines because of its greater length and weight. With the table in the extreme right position and the leveling instrument on the top finished surfaces of the bed at position "X" (Figure 9), adjust the two leveling screws at "1" until the leveling instrument indicates level in a direction at right angles to the bed ways. Then, with the leveling instrument at position "Y", adjust the screws "2" (Figure 9) until the leveling instrument indicates level both lengthwise and across. Repeat the operation, adjusting screws "3" with the leveling instrument at position "Z" until it indicates level both lengthwise and across. Adjust the screws at points "4" just enough to solidly contact the floor and prevent the machine from sagging. Re-check for level at the three positions indicated and lock all of the leveling screws in position.

Foundation Bars and Anchor Bolts. Experience has proven that long center-type grinders which must size to extremely close limits will perform better if anchored to the foundation. For this purpose, suitable anchoring and aligning elements, illustrated in Figure 10, are supplied with the 72" and 96" length machines. Detailed foundation plans are shipped with these machines.

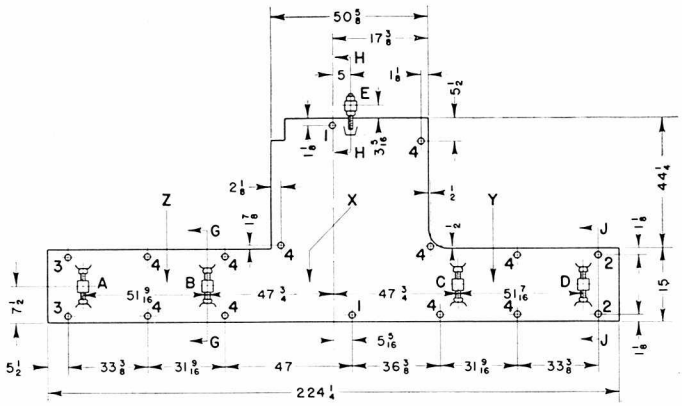

Figure 9
Location of Leveling and Aligning Screws
10″ x 96″ Machine

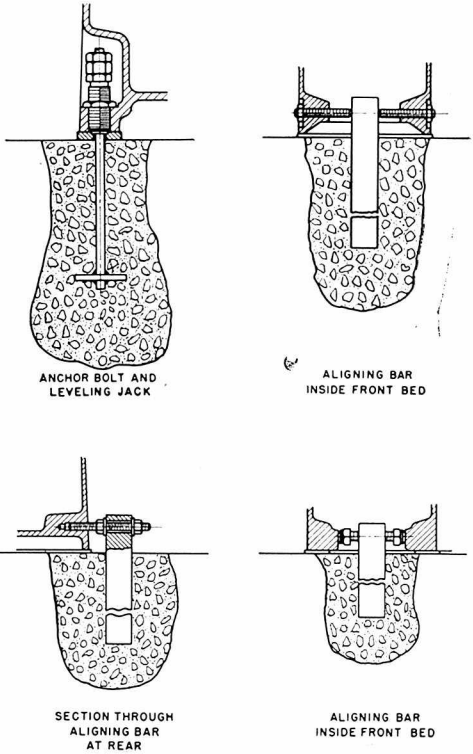

Figure 10
Foundation Bars and Anchor Bolts Supplied with 72″ and 96″ Length Machines

LUBRICATION

The importance of proper lubrication cannot be over-emphasized. The continued accuracy and long life of the machine depend largely upon proper lubrication at all times, so do not neglect lubrication after the machine has been installed. Read the "Lubricating Instructions and Specifications" carefully (pages 20-21). It is extremely important that you use only the grades of oil which meet these specifications. The following paragraphs present a general description of the lubricating systems.

Spindle Bearings. The grinding wheel spindle bearings are of multiple shoe construction, steel backed and bronze lined, and self-adjusting for variations in load imposed by the amount and rate of stock removal. The spindle is supported at both ends by these shoe-type bearings, while a self-adjusting and self-aligning plain bronze thrust bearing, located in the center of the spindle, takes the thrust load.

The lubrication of the spindle bearings is a very important factor in the ability of the CINCINNATI Plain Hydraulic Grinding Machine to take heavy cuts and to produce extremely smooth finishes. A motor and pump, in the rear of the wheelhead unit, pump oil from the reservoir, which is in the same unit, to the spindle bearing compartment. The glass sight gage mounted on top of the wheelhead is connected to the bearing compartment by means of a small orifice in the cap. As the bearing compartment fills with oil, the air escapes through this small orifice until finally the entire bearing compartment and the sight gage are filled with oil. There is a continuous flow of oil up through the orifice into the sight gage, from where it is directed through the oil return back to the reservoir.

When the oil in the bearing compartment reaches the proper working pressure, it actuates a pressure switch in the electrical circuit and then the grinding wheel drive motor may be started. Conversely, if the pressure drops below the pressure setting, the grinding wheel drive motor will automatically stop. This is an important safety feature of the machine which insures perfect lubrication of the spindle bearings at all times. The pressure switch has been properly set before the machine is shipped. Should it cease to function, it should either be sent to our factory for repairs or replaced by a spare unit of the proper setting.

The sight gage provides a visible check on the condition of the oil as well as the presence of oil. For example, if the oil is appreciably lighter in color than normal, it is probably diluted with grinding coolant. If the oil is considerably darker than normal, it is dirty. In either case, the oil reservoir should be drained and the system refilled with clean oil.

There is a strainer for cleaning the spindle oil which should be removed and cleaned at least once every six months. Remove the sheet metal cover from the rear of the cross slide. You will then notice the strainer, which is located in the right rear side of the wheelhead cross slide (Figure 11). Remove the six cap screws which hold the strainer in place and pull it out of the cross slide. Clean the strainer by washing it in naphtha. Also shown in Figure 11 are the two pressure adjustments for the spindle oil. No. 1 regulates the pressure of the oil in the spindle bearing compartment, which should be approximately 7 pounds per square inch. No. 2 regulates the pressure of the oil used to operate the spindle reciprocator, if it has been supplied, which should be approximately 80 pounds per square inch. The pressure in the bearing compartment may be checked with a gage attached in place of any of the $\frac{1}{4}$" pipe plugs which seal the openings in the top of the bearing compartment near both ends of the spindle. The pressure in the reciprocator may be checked with a gage attached to the rear of the reciprocator cap, in place of the right hand $\frac{3}{8}$" pipe plug, looking at the rear of the cap.

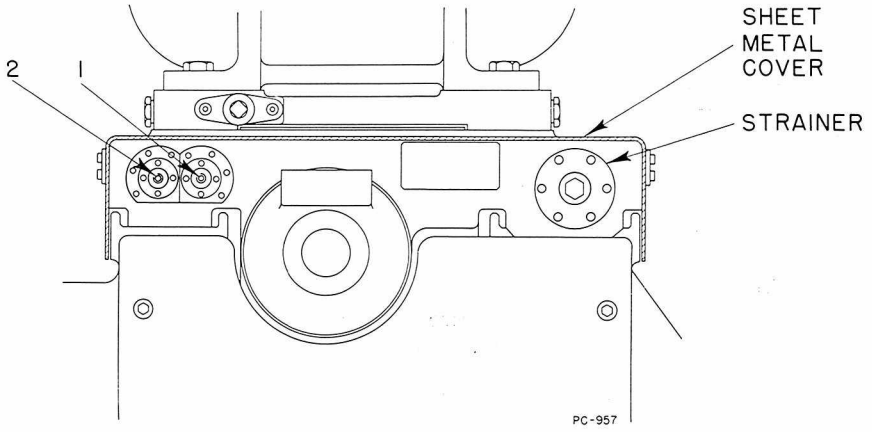

Figure 11
Rear View of Wheel Head Cross Slide

Use only an oil which fulfills the specification requirements for lubricating the spindle bearings. If you use a heavier oil, you may damage the bearings. If you find it necessary to use a different brand of oil than was originally used in the machine, drain out the old oil and thoroughly clean the reservoir before adding the new oil.

Table and Wheel Head Ways. The table and wheel head ways are pressure lubricated with filtered oil from a vane pump, mounted in tandem with the hydraulic oil pump at the left rear of the bed. The oil is pumped to the central portions of the table and wheel head and flows outward to both ends of the units, as shown in Figure 12. This continuous flow of oil away from the ends of the ways effectively prevents the entrance of foreign matter and, in addition, the ways are completely enclosed by guards. Covered peep holes in the telescoping table way guards provide a visible check of the flow of oil over the table ways.

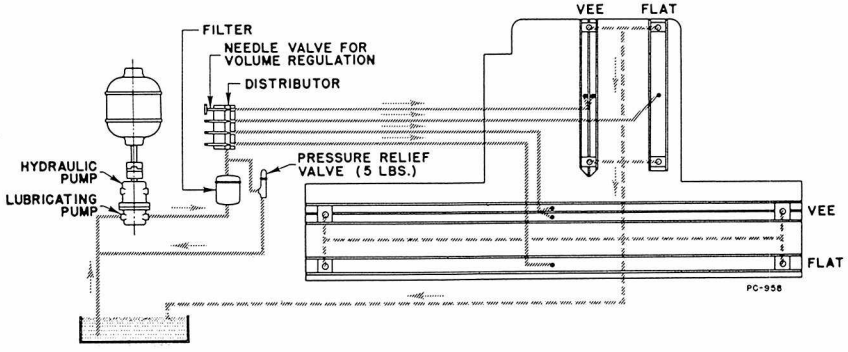

Figure 12
Diagram of Ways Lubricating System

The oil flow may be regulated by means of four valves in the distributor at the left rear of the machine (Figure 13); see page 49 for method of regulating. These valves control the volume of oil only. The pressure is adjusted by means of a relief valve. A filtering unit, mounted near the pump, purifies the oil pumped to the ways and should be renewed at least once a year.

For best results, use only the oil specified.

Hydraulic System. The successful operation of the hydraulic system is to a large extent dependent upon the use of the right grade of oil and in keeping this oil clean. The cleanliness of the oil may be assured by being certain the oil used to fill the system is clean and by periodically renewing the filter, located at the left rear of the machine (Figure 13), every six months.

Oil Reservoirs. The lubricating and hydraulic oil reservoirs are cast integral with the front section of the bed and are filled through standpipes at the rear of this front section. The hydraulic oil reservoir is filled through the standpipe at the right rear (Figure 14) and holds about 23 gallons. The lubricating oil reservoir is filled through the standpipe at the left rear (Figures 13 and 14) and holds about 5 gallons. Oil levels may be checked by the "bayonet" gages incorporated in the caps of the standpipes. The "bayonet" gages replace the glass sight gages which were used in the earlier machines.

The spindle oil reservoir is filled through the pipe elbow on the right side of the wheel head and holds about 6 gallons. A dial gage indicates the oil level in the reservoir. To drain the reservoir and the spindle bearing compartment, loosen the drain screw four or five turns (Figure 31), thus allowing the oil in the bearing compartment to drain back to the spindle oil reservoir. Remove the cover from the rear of the bed, run the wheelhead back to its maximum rear position, remove the pipe plug which is now protruding from the rear of the machine and drain the oil into a container

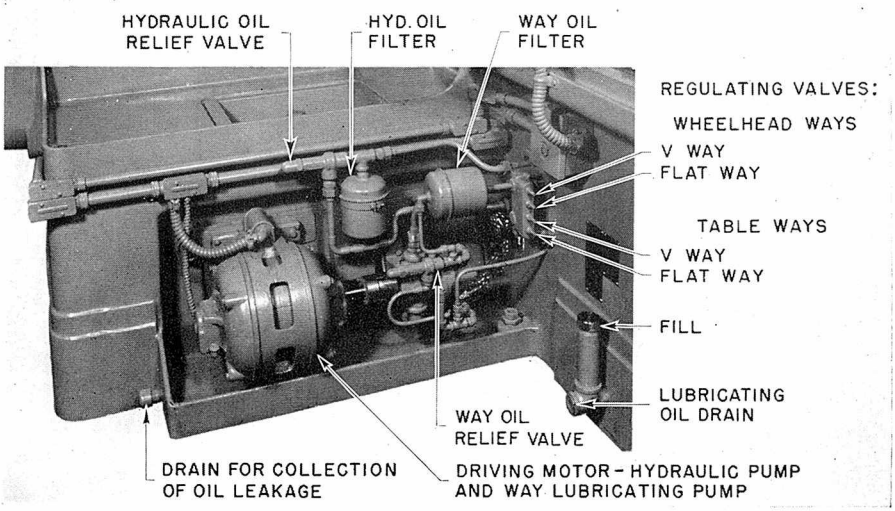

Figure 13
Rear Corner of Bed with Cover Removed to Show Way Lubricating and Hydraulic Elements

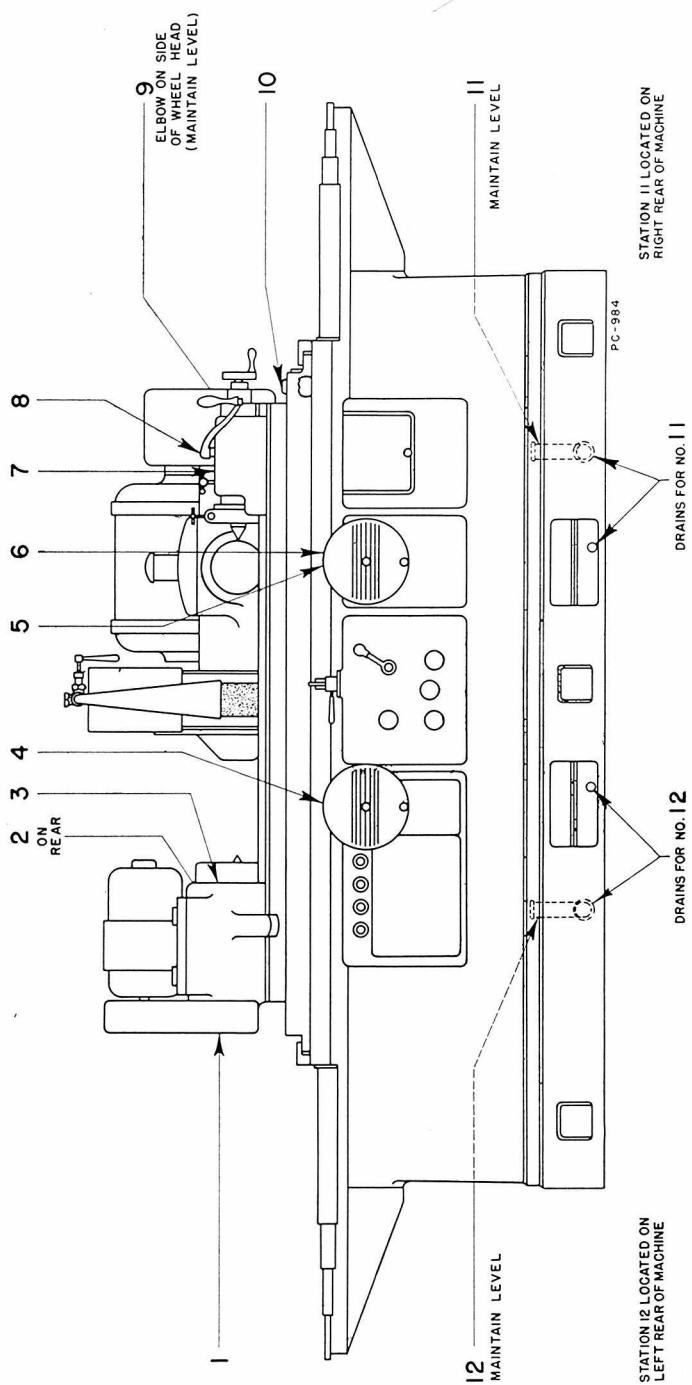

Figure 14
Lubricating Diagram

LUBRICATING INSTRUCTIONS AND SPECIFICATIONS
10″ PLAIN HYDRAULIC GRINDING MACHINES (MODEL ER)

When to Oil	Station Number (See Fig. 14)	Instructions	Parts Lubricated	Specifications
Daily	1 and 3	Apply one or two shots with a grease gun	Headstock secondary drive shaft	P-37. Any good grade of cup grease, free of acid and fillers
*Daily	2	Oil with a bench oiler	Headstock spindle bearings	P-31. Medium quality machine oil. Viscosity 190 to 210 seconds Saybolt at 100° F.
Daily	4	Oil with a bench oiler	Table traverse servo drive shaft	
Daily	5 and 6	Oil with a bench oiler	Graduated ring scale and pick feed pawl	
Daily	7 and 8	Oil with a bench oiler	Footstock screw and lever shaft bearing	
Weekly	10	Oil with a bench oiler	Table swivel screw	
6 months	9	Drain and refill every 6 months, (If available, use hand pump to fill). Six gallons required	Wheel spindle bearings	P-45. High grade light bodied spindle oil. Viscosity 100 to 130 seconds Saybolt at 100° F.
6 months	11	Same as Station 9. Twenty-three gallons required	Hydraulic system	P-38. High quality light hydraulic oil. Viscosity 148 to 155 seconds Saybolt at 100° F.
12 months	12	Same as Station 9, except interval is 12 months. Five gallons required	Table and wheel head ways	P-47. Table way oil. Viscosity 300 to 350 seconds Saybolt at 100° F. Example: Sun Oil Co. table way oil P-47

*Adjust rate valve of Station 2 to use ½ cup a day.

GENERAL OPERATING INSTRUCTIONS

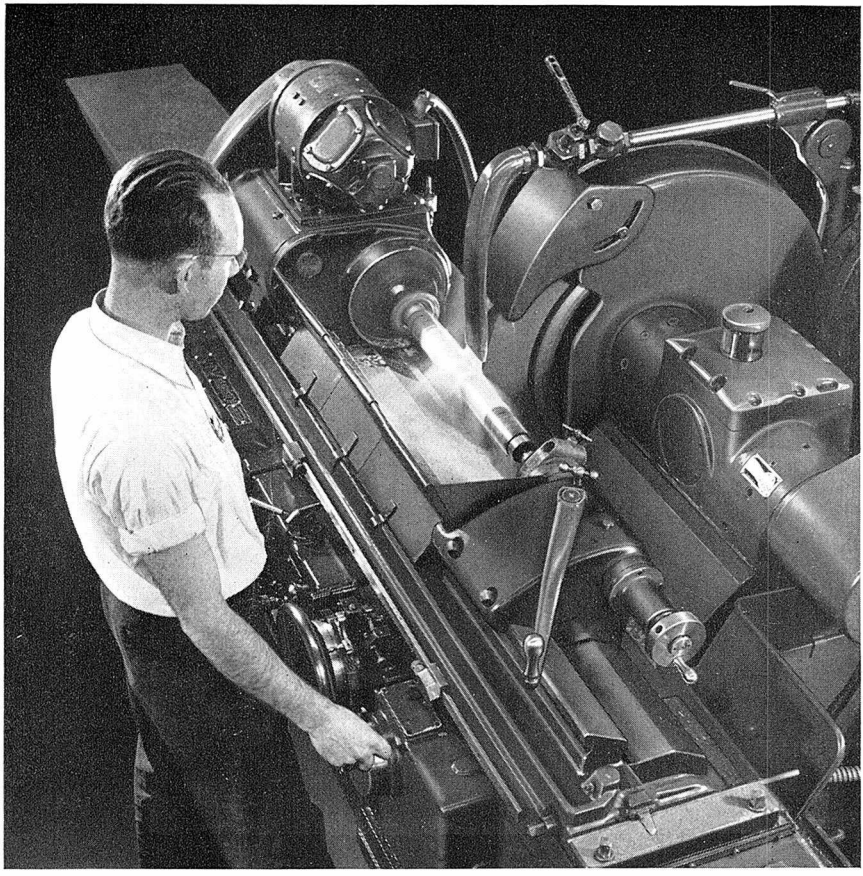

Figure 15
A typical production set-up of grinding the center diameter of a three-key spline shaft. The machine is equipped with the hand Servo infeed attachment —a convenient and rapid production feature for grinding this and two other diameters.

The information contained on the large red warning tag tied to the machine is important. Follow the instructions given thereon.

Starting a New Machine for the First Time. After the machine has been properly installed, wash off the slushing oil and dirt accumulated in transit, using naphtha or some similar solvent of grease. Fill all of the reservoirs and lubricate the machine in accordance with "Lubricating Instructions and Specifications". Momentarily start the motors and notice their direction of rotation. The motor shafts must rotate in the directions indicated by the metal tags mounted on or near the motors.

Warning: Do not run any of the motors until the oil reservoirs have been filled.

Allow the motors to run for several minutes and then check to be certain that the oils are reaching the points which they are intended to lubricate. It may be necessary to prime the lubricating oil pump (see page 49).

Try all movements of the hand controls to familiarize yourself with the machine. Set the table dogs for a full stroke reciprocating cycle and allow the machine to run idle for an hour or so to insure complete lubrication of all the bearings and to expell all of the air from the hydraulic system.

Use of Electrical Control Panel. The electrical control buttons are conveniently grouped in the left-hand panel on the front of the bed. The red button on the right is the master stop. Pressing this button stops all of the motors on the machine.

The button next to the stop button is for starting the hydraulic and lubricating oil pump and the spindle oil pump. After the proper working pressure has been built up in the spindle bearing compartment, pressing on this button a second time will start the grinding wheel drive motor. Working pressure is built up in several seconds unless the spindle bearing compartment has been drained or the machine has been idle for a lengthy period, during which time the oil has slowly drained from the compartment back to the reservoir.

The next or third button to the left controls the headstock and coolant pump motors. If the button is turned to the left, the coolant pump and headstock motors will both run. If the button is turned to the right, the

coolant pump motor will run independently of the headstock, which is a convenience for wheel truing. If the button is turned with the arrow pointing straight up, neither motor will run. The operation of the headstock motor is dependent upon the position, of the "Start-Stop" traverse lever or the hydraulic infeed lever, if the latter is supplied.

The next button, the one at the far left, is included only when the machine is equipped with an hydraulic infeed attachment. This button should be turned to the left for traverse grinding or to the right for infeed grinding. In the stop position, it is impossible to grind by either method.

Control Levers, Hand Wheels and Knobs. (Refer to Figure 16). Hand table traverse is controlled by hand wheel "E". You will find that the table responds to a very light pressure on the hand wheel. If the movement seems to be too free, as when grinding against a shoulder, the drag adjustment "A" may be used to establish a slight "feel" in the movement of the hand wheel.

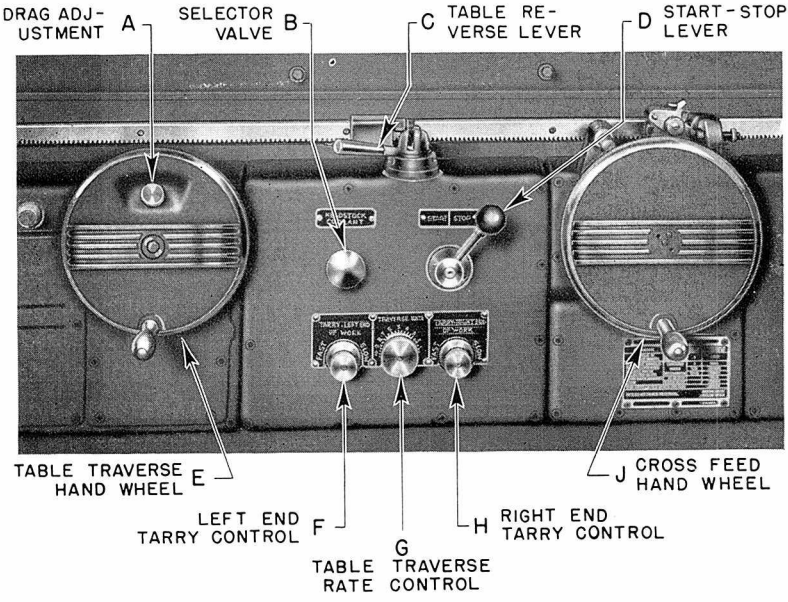

Figure 16
Operating Controls

Control of the headstock and coolant, independent from table traverse, is through knob "B", located on the upper left of the control panel. Pull this knob out to start the headstock and/or coolant or push it in to stop them. This knob is not supplied when the machine is equipped with the hydraulic infeed attachment, for then it is not needed.

Lever "C" controls the reversing valve, which in turn controls the direction of table movement. When a traverse grinding job is set up, dogs automatically reverse the table by acting against this lever.

Two knobs, "F" and "H", control the tarry at each end of the table stroke. Independent tarry controls of this sort are especially useful when grinding the type of work shown in Figure 17. Here the grinding wheel can overrun the end of the work at position "B", but is prevented from doing so at position "A" by the shoulder. Compensation, in the form of a longer tarry at position "A", permits an "evening up" of stock removal. Knob "F" controls the tarry while the table is at the left end of the stroke, while knob "H" controls the tarry at the right end of the stroke. To decrease the length of time of tarry, turn the knobs from right to left. To increase the length of time of tarry, turn the knobs from left to right. The knobs may be set to provide a tarry of from 0 to 5 seconds.

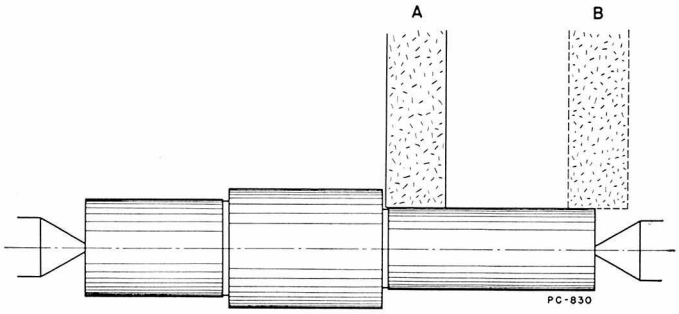

Figure 17
Application of Table Tarry

Knob "G" controls the speed of table traverse, which is infinitely variable from 3 to 220 inches per minute. To increase the speed, turn the knob from right to left. To decrease the speed, turn the knob from left to right.

Lever "D" controls the starting and stopping of the work rotation, table movement and pick feed mechanism. Of course, the buttons on the control panel must be properly set for this.

Cross movement of the wheelhead is controlled by hand wheel "J", explained completely under "Cross Feed Mechanism".

Headstock. An infinite number of headstock speeds, within the ranges listed in the specifications, may be obtained by turning the rheostat control at the front of the bed. The headstock is clamped to the table by means of hinged L-type clamps, which are operated from the clamping screws "A" at the front of the headstock, Figure 18. The headstock can be positioned on the table by use of the rack and pinion "B".

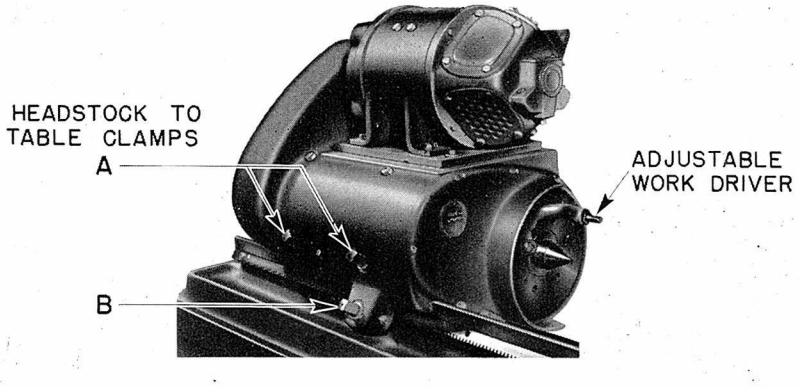

Figure 18
Headstock

Cross Feed Mechanism. The hand wheel shown in Figure 19, along with its several component parts, controls all cross feed movements of the wheelhead, whether hand or automatic feed. The variations possible are shown on the plate attached to the machine just below the hand wheel and reproduced in Figure 20.

It is seen that a comparatively coarse hand cross adjustment is possible when the handle is in, turning the mechanism directly. Fine adjustments are attained by simply pulling out the handle, turning the hand wheel

clockwise the desired number of slots through the index mechanism, and then re-engaging the handle. This action has moved the sliding stop away from the positive stop. Now turn the hand wheel counter-clockwise until the stops are solidly engaged. The pick feed pawl is used as a positive stop by swinging it back about 180°.

The sliding stop is attached to the graduated ring which is directly behind the hand wheel. Large and moderately small adjustments for stock removal may be made by disengaging the locating pin in the sliding stop and moving the sliding stop back away from the positive stop until the desired amount of stock removal shows on the graduated ring beneath the pointer. Now turn the hand wheel counter-clockwise until the stops are solidly engaged. The automatic infeed at each table reversal operates through the pick feed

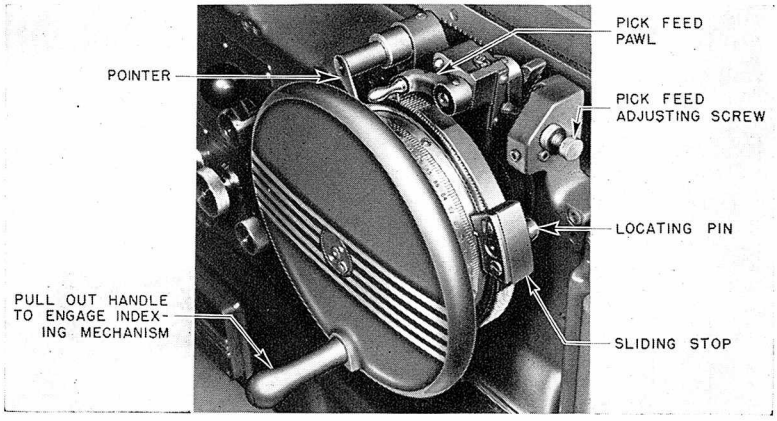

Figure 19
Cross Feed Hand Wheel

mechanism. Notice that with each reversal of the table the pick feed pawl is given a positive movement to the left. This movement is translated into cross feed by engaging the pawl with the ratchet ring. Cross feed in this manner will continue until the sliding stop approaches quite close to the position which will be occupied by the pick feed pawl when it is swung back 180°, at which time the pick feed will be automatically

OPERATION		NO. OF TURNS	REDUCTION IN DIAMETER BY
HANDLE IN RATCHET WHEEL	DIRECT	1	100
PULL OUT HANDLE- TURN CLOCKWISE- LOCATE PIN IN SELECTED SLOT- TURN BACK AGAINST STOP	THROUGH INDEX MECHANISM	1	.001
		1/2	.0005
		1/10	.0001
	10 SLOTS		.001
	EACH SLOT		.0001
ONE GRADUATED SPACE ON DIAL			.0004
INFEED AT TABLE REVERSAL			MIN. .0004 MAX. .0028

PC-901

Figure 20
Cross Feed Instruction Plate

disengaged. The remainder of the cross feed movement is obtained by turning the wheel by hand until the sliding stop contacts the positive stop.

The amount of cross feed movement at each table reversal may be varied by means of the adjusting screw (Figure 19). The pawl may be adjusted to pick any number of notches from 1 to 7, which is the equivalent of from .0004″ to .0028″ in diameter reduction.

SETTING UP THE MACHINE

Assembling the Grinding Wheel Mount. The unit, consisting of the collet, wheel, flange, screws, pin, key and washers, referred to in this book as the wheel mount, is easier to assemble if the collet is placed on a bench. The parts are assembled on the collet as shown in Figure 21.

When mounting a new wheel, do not force it on the collet because of the danger of starting a crack in the wheel. The wheel should fit the collet with a clearance not exceeding .005" on the diameter.

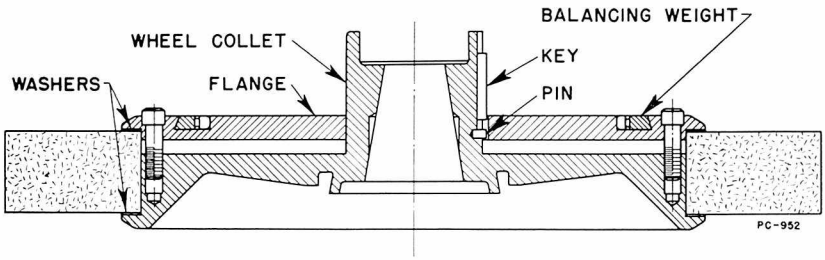

Figure 21
Section Through Wheel Mount

Compressible washers or blotting paper washers should always be placed between the sides of the wheel and the collet and flange in order to evenly distribute the clamping pressure. Very satisfactory results can be obtained with safety type washers, which consist of a very thin sheet metal base covered with rubber. To further even distribution of clamping pressure, when inserting the collet screws, lightly tighten them prior to applying a consistent locking action around the periphery of the collet.

It is advisable when changing wheels, if a 2 inch or thinner wheel is used, to check the screws and make sure they do not extend into the slinger groove on the inside of the collet.

We strongly recommend the use of a separate wheel mount for each wheel regularly used. Such practice saves time required for balancing and truing and prolongs the life of the wheel.

IMPORTANT: The wheel mount should be removed from the spindle at least once every month to clean the grit out of the slinger grooves in the

back of the collet and the drain hole in the oil retainer on the outside of the wheelhead housing. This permits free drainage of any coolant which might get between the wheel collet and retainer. If this is neglected, coolant and grit may enter the oils seals and eventually damage the spindle bearings.

Balancing the Grinding Wheel. Wheel balance is one of the fundamental requirements that must be observed in order to meet present day requirements for fine finishes and close tolerances and to realize normal wear of the wheel, diamond and spindle bearings. The advantages of proper wheel grading, well conditioned equipment and skillful operation are without value while there exists an out-of-balance condition of the wheel.

Most new wheels are inspected for balance by the manufacturer, but the method of assembling the wheel mount, which must necessarily allow a slight clearance between the wheel and collet, makes rebalancing essential. The procedure for balancing either a new wheel or one that has been removed from the collet is essentially the same, the various steps necessary being outlined as follows:

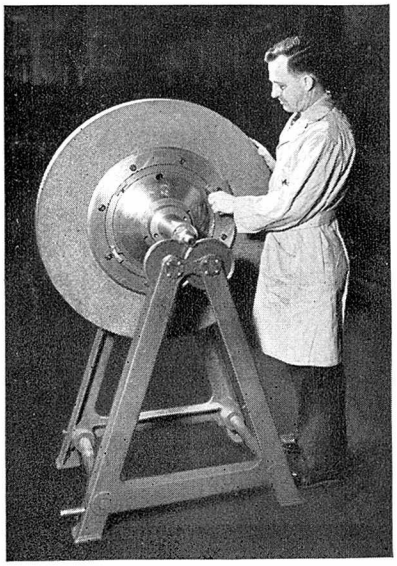

Figure 22
Wheel Balancing Stand

1. Assemble the grinding wheel mount as described on page 29.

2. Place the wheel mount on the spindle nose and roughly true the periphery of the wheel. Allow the wheel to run for several minutes with the coolant turned off before starting the balancing operation. If this precaution is not observed, retained water in the wheel will indicate a false heavy side.

3. Remove the entire wheel mount from the spindle and insert the balancing arbor into the wheel mount. Now place the entire unit on the balancing stand, being sure that the stand is reasonably level (Figure 22).

4. Remove the four sliding balancing weights from the flange and allow the wheel to turn until it has come to rest with the heavy side down. Mark this heavy point with a chalk mark and also mark a horizontal line through the wheel axis (Figure 23).

5. Place the four balancing weights in the groove in the flange, spaced at approximately 90 degrees intervals. The addition of the weights in these positions should not alter the position of the heavy side.

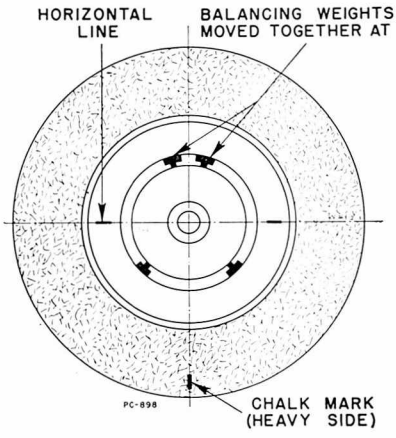

Figure 23
Balancing Procedure

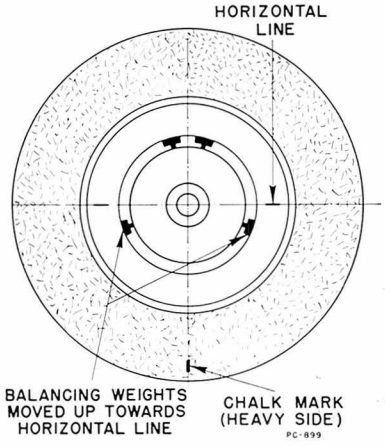

Figure 24
Balancing Procedure

6. Move the two top weights towards one another, as in Figure 23, until arriving at conditions of perfect balance. If, when the two top weights are moved towards one another until they touch, the wheel is still out of balance, it will then be necessary to move the two lower weights up towards the horizontal chalk mark until the wheel is in balance, as in Figure 24.

7. Turn the wheel to various positions to see if the out-of-balance condition has merely shifted instead of being corrected. In such an event, mark the new heavy side and re-adjust the weights accordingly.

8. Remove the balancing arbor, place the wheel mount on the spindle nose and accurately true the wheel for grinding.

Truing the Wheel. An important factor in maintaining satisfactory production and obtaining the best possible finish on the workpiece is a free cutting wheel. Given a certain grade of wheel, the only way it can be kept in a free cutting condition is to carefully dress it often enough to prevent it from becoming glazed or loaded with particles of metal from the workpiece.

The truing device, which is included as standard equipment, consists of a bracket attached to the footstock and an adjustable bar for carrying the diamond nib. The adjustable bar is tilted downward, producing the correct "wiping" action of the diamond across the face of the wheel. If you wish to true the sides of the wheel, turn the adjustable bar end for end and insert the diamond nib in the cross hole. It is then advisable to tighten the drag adjustment "A" (Figure 16) to positively position the table.

Since production and finish, not to mention the life span of the diamond, are affected by the truing operation, it is important that you observe a few elementary precautions. Clamp the tailstock firmly to the table and lock the tailstock spindle in position with the hand screw clamp "A" (Figure 25). As soon as the diamond contacts the wheel, turn on the coolant. We do not recommend dry truing for any type of wheel or truing device.

Do not remove more than .002" per pass. This setting is easily governed by adjusting the cross feed hand wheel. The rate of traverse of the truing tool across the face of the wheel should not be too rapid or both the life of the diamond and finish of the work will be adversely affected. The truing traverse rate for a diamond tool should be approximately 10" to 20" per minute for rough grinding operations and 4" to 7" per minute for finish grinding operations. It is a good plan to stop the headstock motor while truing the wheel.

The maximum life of the diamond will be realized by rotating the holder after each few passes across the wheel face, presenting new cutting edges to the wheel, and by having the diamond re-set when it becomes worn.

Placing the Work in the Machine. Inspect the centers of the work and machine, for imperfect centers will not allow production of accurate work. Set the headstock and footstock at such a distance apart that the spring in the footstock is but slightly compressed when the work is in grinding position. Remember that the headstock and footstock are both moveable units, so that the work may be held in the center of the table rather than always near the headstock end of the table.

Lever and Hand Wheel Retraction of Footstock Center. When grinding comparatively light work with a moderate rate of stock removal, the lever control for advance and retraction of the footstock center may be economically used to advantage because it is much faster than the hand wheel operated screw. On the other hand, when grinding heavy work, work with a high rate of stock removal, or extremely small work, the knurled hand wheel control of the center should be used. This positive control acts as a safety measure to prevent retraction of the center while grinding heavy work or work with a high rate of stock removal, and to prevent buckling of extremely small work from spring pressure.

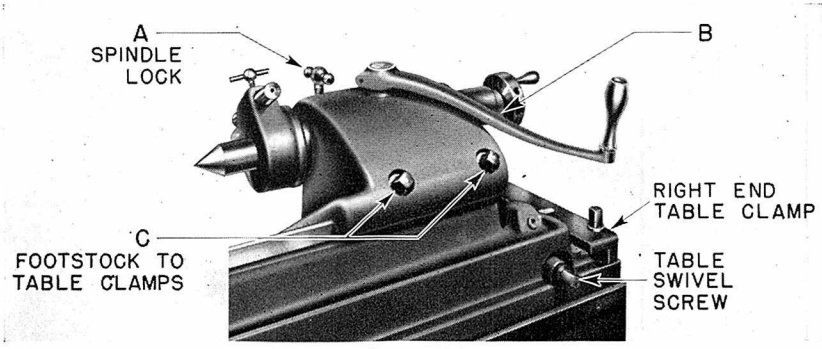

Figure 25
Footstock

To change from lever control of the footstock center to positive hand wheel control, tighten headless screw "B" adjacent to the handwheel. (Figures 25 and 36). This firmly clamps a sleeve in position and prevents movement of the footstock center by the hand lever. The movement is now controlled by the hand wheel only. An expansion compensating spring is built into the footstock spindle in order to prevent excessive pressure on the centers when the spindle is positively positioned by the screw. The spindle can be locked in position by hand screw clamp "A". Screws "C", through L-type clamps, are used to clamp the unit to the table.

When inserting the center in the footstock spindle be certain that both are perfectly clean. Solidly seat the center but do not drive it into the footstock spindle. Should the center accidentally become stuck or frozen in the spindle, do not try to remove it by excessive twisting pressure on the footstock screw because several of the internal parts may become severely strained or broken. Remove the cap and footstock screw from the right end of the unit and then drive out the center, using a $\frac{5}{8}$" diameter bar.

Reversing Dogs. Adjustable dogs on the front of the table may be set to reverse the direction of table travel by acting on the reversing lever. Coarse adjustment is made by simply pushing down on the dog and sliding it along the rack to the desired position, as in Figure 26. Fine adjustment is accomplished by adjusting the knurled screw on the inner end of the dog. This, along with accuracy of table reversal within .004″, permits power table traverse to be used when grinding close to shoulders. Power table reversal may be set as short as $\frac{3}{32}$″ with the dogs.

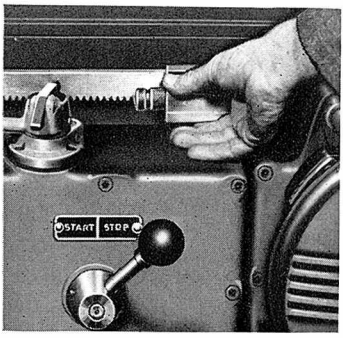

Figure 26
Reversing Dog

Should you desire to true the wheel while the dogs are set for power reversal of the table, it will not be necessary to move the right hand dog in order to bring the diamond holder in line with the face of the wheel. The forward portion of the reversing lever is pinned in such a manner that it may be swung up to clear the top of the dog.

Back Rests. On all center-type work which is of such size or weight that it will either bend under its own weight or be deflected appreciably upon contact with the grinding wheel, it is necessary to use back rests to insure that the work will be ground both round and straight. The back rests used with this machine, the screw type or spring type, are supported by and clamped solidly to the table. The lower of the two replaceable wood blocks supports the work forward of its axis and tends to force the work up and back against the second wood block, creating a wedging action. As the work is ground, compensation for stock removal is made by feeding in the upper wood block.

Flow of Oil to Table Ways. Too much oil supplied to the table ways will tend to "float" the table and will overflow. This is especially true when plunge cut grinding. This results in less accurate grinding and, too, the lubricating oil overflow from the table ways drains into the hydraulic oil reservoir. So it is good practice to reduce the flow to the table when plunge cut grinding (see page 49, "Adjusting the Volume of Oil to the Ways"). However, in the interests of safety, never cut out the flow completely, and be certain to return it to normal when resuming traverse grinding.

GRINDING COOLANT

A solution of soluble oil and water has been found satisfactory for a general class of work. When grinding steel a solution of 1 part of soluble oil mixed with 20 to 40 parts of water will give satisfactory results.

One part soda solution (about 25% concentration) should be added to the above mentioned coolant when grinding cast iron.

It has sometimes been found advisable to add about 2 parts of kerosene instead of soda to the above mentioned solution when grinding aluminum. The kerosene tends to keep the soft aluminum out of the pores of the wheel and also assists in preventing glazing of the surface of the wheel.

Paraffin oil should be used as a coolant when grinding fibre.

Use hydrant water when grinding rubber, carbon, casein, etc., and reject the waste into the sewer or a large settling tank. The stock removal is usually high and the standard tank is not large enough.

For best grinding results, keep the coolant tank filled to its capacity.

CLEANING THE COOLANT RESERVOIR

The coolant reservoir is cast integral with the rear section of the base. Once or twice a week or as often as the work demands, depending upon the stock removal and machine working hours, this reservoir should be drained and cleaned.

On the left side of the grinding wheelhead you will notice a pan set into the base. Remove this pan. Through the opening made available by the removal of the pan on the right of the wheelhead (looking at the rear of the machine), turn the three-way valve "A" one-quarter turn counter-clockwise (Figure 27). With the valve in this position the pump intake is near the bottom of the reservoir, permitting nearly all of the coolant to be pumped out. The valve is not visible when the reservoir is filled because it is submerged in the coolant.

Disconnect the hose from the pipe at the top of the wheel guard and pump the coolant into a container. Now remove the plate over the clean-out opening on the rear of the bed near the floor line (Figure 28) and scrape the sludge out into a flat pan.

After the reservoir has been cleaned and refilled with coolant, be certain to turn the three way valve back one-quarter turn clockwise to its original position. If this is neglected, grit and particles of metal, which settle to the bottom of the reservoir, will be drawn into the coolant circulating system. Cap "B" (Figure 27) should be lifted off the upper intake tube and simply turned over to release any air and then placed back on the intake tube. This is important for the pump will not draw coolant unless this cap is free from air.

Before starting a job which requires an extremely smooth finish, it is advisable to also clean the inside of the wheel guard. The finish on the workpiece will then be free from scratches caused by grit and particles of metal circulating with the coolant.

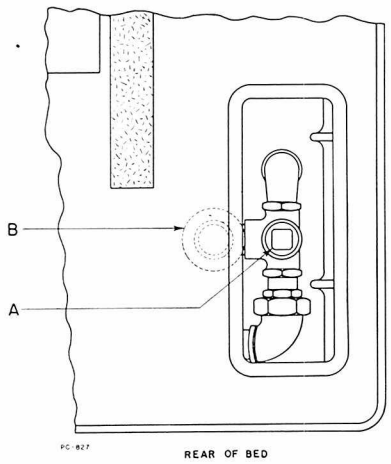

Figure 27
Three-Way Coolant Valve
for Pumping Out Reservoir

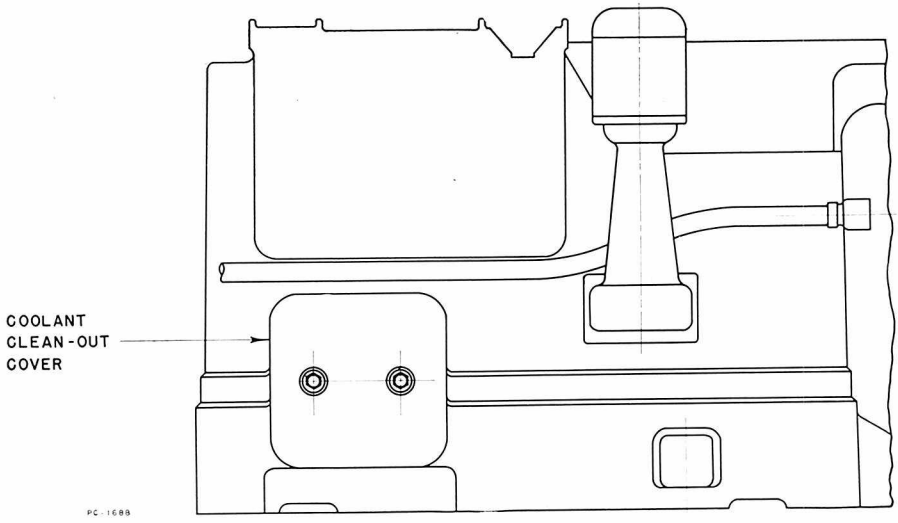

Figure 28
Rear of Machine, Showing Coolant Clean-out

SAFETY PRECAUTIONS

Grinding Wheels. Immediately upon receipt, all grinding wheels should be closely inspected to be sure that they have not been injured in transit. Inspect for cracks by tapping gently (while suspended) with a light implement, such as the handle of a screwdriver. Wheels must be dry and free of sawdust when applying this test. If they do not emit a clear, ringing sound, they should not be used. New wheels should be run at full operating speed for at least one minute before applying the work, during which time the operator should stand at one side. Wheels should be stored in a dry place and supported by pegs in racks.

Grinding Wheel Speed. Most grinding wheels for center-type grinders are designed to operate at about 6,000 surface feet per minute and, accordingly, many companies mark their wheels to show the highest speed at which they should be run. This machine is equipped with an extra sheave for maintaining proper speed as the wheel wears down, but has provisions for preventing a large wheel from being run at too high a speed. Any attempt to alter this safety device or to employ any other method of increasing wheel speed is a highly dangerous practice which will only invite accidents.

Set-Up. The adjustable units, such as headstock, footstock, wheel head, back rests and wheel guard, should be solidly clamped in position before starting to grind. Should any of these units move during the grinding operation, a serious accident may result.

Work and Machine Centers. The machine centers should be periodically ground so that they may be kept in perfect condition at all times. Likewise, the work centers should be properly drilled and free from dirt or burrs which might cause trouble. The centers must be lubricated to prevent overheating and possible pick-up. While speaking of centers, be certain that the work is actually between centers and not centered at one end only. While concentrating your attention on engaging the footstock center, it is possible that the headstock center may actually come to rest between the work and the dog, or on the flat end of the work. The eccentricity caused by this error may throw the workpiece into the wheel with disastrous results.

Interferences. On machines which are equipped with the hand hydraulic or automatic hydraulic infeed, the length of infeed at a rapid rate is nearly one inch. Be positive that at least this much clearance is available before

bringing the wheel head into position for either grinding or truing. Also check for clearance between the driving dog and grinding wheel and between the tailstock center and grinding wheel. On all machines equipped with hand servo infeed or automatic infeed, be sure to set up for size with the infeed lever in the down position. Any of these, as well as many other possible interferences, if not taken into account, may cause an accident.

Application of Wheel to Work. Good judgment must be exercised in feeding the wheel into the work, for thin shafts may bend or a workpiece of any size may be forced from between the centers by excessive pressure. When shoulder grinding, avoid excessive pressure of the work against the wheel to preclude the possibility of forcing the work from between centers, or even breaking the wheel from side pressure.

Keep Hands Away From Wheel. With a little care and foresight, the grinding operation may be planned so that loading and removal of small work is done with the hand off to one side of the grinding wheel. Besides trying to avoid accidentally touching the wheel, do not invite trouble by feeling the face or sides of the wheel with the fingers, in an effort to determine the smoothness or condition of the wheel.

FACTORS GOVERNING PRODUCTION

This section has been included so that the less experienced grinder operator may become briefly acquainted with the principles of the grinding art as related to production. While it is true that modern center-type grinding machines possess unparalleled built-in skill and operating features which contribute greatly to successful high production grinding, there remain certain factors which govern the output of the machine that must be fully appreciated if maximum production is to be realized. The various factors are considered singly in subsequent paragraphs.

Grinding Wheel Speed. The machine has been designed so that the peripheral speed of the grinding wheel is approximately 6000 surface feet per minute, which is considered correct for modern abrasive wheels. When operating below this speed, the wheel will appear to be softer and will wear in proportions not consistent with the average wheel life which should be obtained. To avoid this situation, extra sheaves are supplied for this machine for increasing the grinding wheel speed after the wheel has worn down to a predetermined diameter, providing maximum efficiency until the wheel is completely worn out. See "Instructions for Changing Sheaves", page 51.

It is highly important that the grinding wheel speed be maintained during the cut. Proper adjustment of drive belts and precautions against overloading the motor are steps which should be taken to prevent slowing down while grinding. This momentary slowing down rapidly breaks down the face of the wheel, often to such an extent that re-truing is necessary. It is not difficult to see that, with time spent for more frequent truing and changing of wheels, production will be adversely affected.

Grade and Grain Size of Wheel. The grade and grain size of the grinding wheel used are dependent upon the type of material being ground, its size, speed, stock removal and finish required. Of these, no single factor can be said to definitely determine the grain size or grade. It is rather a combination of the various factors in varying degrees of importance.

In general, rough grinding to remove a large amount of stock requires a relatively coarse-grained wheel, while light finishing cuts should be taken with a finer-grained wheel. However, do not allow the requirement of fine finish to influence your selection of too fine a wheel, for fairly fine finishes can be obtained with the coarser wheels by careful dressing and proper selection of work speed.

The type of material determines the grade of the wheel. The harder materials should be ground using a softer grade of wheel, while the softer materials should be ground using a harder grade of wheel. This, too, is a general statement, for it must be remembered that softness and free cutting are synonymous in most cases because the cutting particles of a soft wheel break away before they have become too dull. The softer wheel will practically always permit a faster removal of stock, resulting in increased production.

However, a high work speed will make the action of the wheel appear to be softer, so under these circumstances a harder grade of wheel is required. Conversely, a low work speed will make the action of the wheel appear harder, requiring a softer wheel.

A wheel of coarser grain size and softer grade should be used when grinding work of a large diameter. The large diameter work creates a greater arc of contact between the wheel and the work and provisions must be made to carry away the increased amount of material.

Wheel Width and Table Travel. Wheel width itself has no apparent effect on production except when considered in conjunction with table travel. It is evident that the advantages of supplying a wide wheel (3 inches std. on this machine) are of little value unless an adequate table travel is used which will most effectively utilize the available wheel width. A slow table traverse not only limits production but causes the wheel to wear more on the edges, requiring more frequent truing.

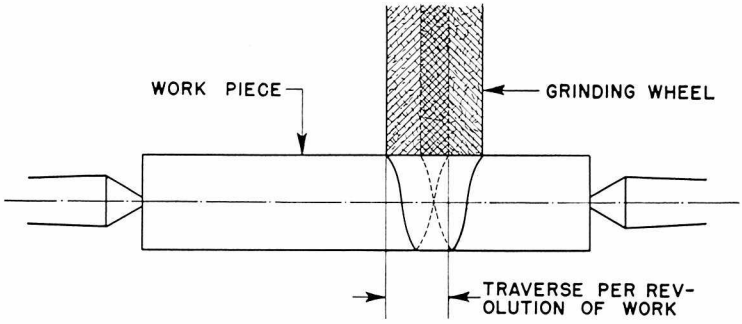

Figure 29
Two-Thirds Width of Wheel Traverse
per Revolution of Work

For rough grinding, the arrangement which will produce the most satisfactory results is to traverse the table from ½ to ⅔ the width of the wheel per revolution of the work. Figure 29 illustrates the favorable distribution of wheel wear resulting from this arrangement. The shading lines which slant left and right indicate the wheel wear when traversing left and right, indicating that the greatest wheel wear is in the central portion of the wheel. This set-up is adaptable to fairly large work only.

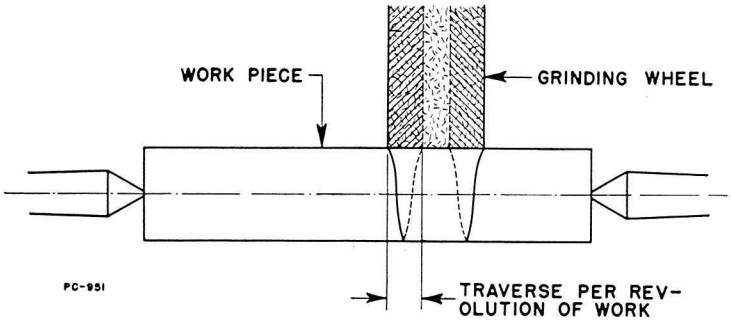

Figure 30
One-Third Width of Wheel Traverse
per Revolution of Work

Figure 30 illustrates the effects of a set-up in which the traverse of the table is about ⅓ the width of the wheel per revolution of the work. Again shading lines indicate wheel wear when traverse grinding left and right, indicating that the central portion of the wheel is not subject to heavy wear, as are the edges. Frequent truing will be necessary to remove the high portion from the face of the wheel.

Finish grinding is naturally done at a much slower rate of table traverse, since surface smoothness rather than wheel wear or stock removal is the predominating factor.

Work Speed. Production is indirectly limited by work speed in that if too slow a speed is used, table traverse is correspondingly reduced. If too high a work speed is used, the full capacity of the wheel width is not effectively put to work, as explained under "Wheel Width and Table Travel".

Avoid extremely low work speeds because of the heating and distortion of the work which will inevitably result. The effect of high and low work speeds on the grinding wheel were discussed under "Grade and Grain Size of Wheel". Rather than try to adjust the work speed until the wheel neither becomes glazed nor breaks down too rapidly, it is better to select a wheel of proper grade which is suited to the work.

Cross Feed. It would seem that production is governed by cross feed but this is true only if cross feed is insufficient. Excessive cross feed while traversing results only in rapid breaking down and waste of the grinding wheel. Maximum efficiency will result from a high rate of table traverse and a comparatively light cross feed rather than a heavy cross feed at a slower traverse rate.

Coolant Supply. An ample flow of coolant is necessary for successful operation, since local heating must be avoided if accurate work is to result. A fairly high traverse rate and work speed, along with ample coolant, will dissipate the heat rapidly enough to prevent any distortion of the work.

PRINCIPAL CAUSES OF UNSATISFACTORY FINISH

1. Too hard or too fine a grinding wheel.
2. Work too slender and not properly supported.
3. Loosely clamped headstock or footstock.
4. Grinding wheel mount fits loosely on spindle nose.
5. Vibrations generated by motor or torn V-belts.
6. V-belts not properly matched, causing whip.
7. Vibrations transmitted from other machines.
8. Grinding wheel out of balance.
9. Grinding wheel loaded with particles of metal.
10. Table ways dry or gummy.
11. Table "floating" on oil.
12. Too heavy stock removal.
13. Improper tension on headstock belts.
14. Inaccurate leveling of bed.
15. Inadequate foundation.
16. Center holes in workpiece not accurate.
17. Machine centers not accurate.
18. Dirty or insufficient coolant.
19. Spindle bearings out of adjustment (any one of first 18 causes more likely).

ADJUSTMENTS

Many of the adjustments and minor repairs, which are described below, can easily be accomplished when competently supervised by your own maintenance department. Let us stress that the need for many of these adjustments will be greatly lessened if the machine and its lubricating oils are kept clean at all times. In line with this is a reminder to replace all covers and guards immediately after an adjustment or repair job to prevent dust and grit from getting into the oil in the machine.

Adjusting the Main Drive Belts. The main drive V-belts, from the motor sheave to the spindle, may be adjusted for stretch and wear. On each side of the wheelhead you will find two hexagon head screws "A" (Figure 31). These four screws clamp the motor slide in position. Loosen them and the motor may be freely slid forward or backward by turning the screw "B" at the rear of the wheelhead slide.

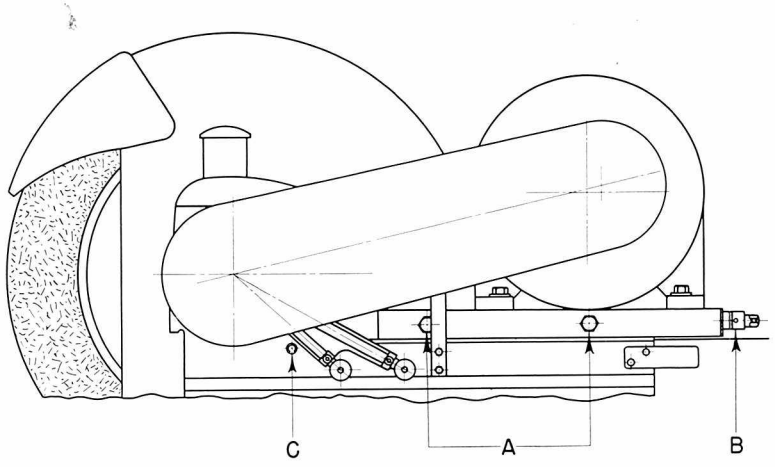

Figure 31
Wheel Head—Right Side View

To obtain the best results and at the same time be assured of no damage to the spindle bearings, it is well to leave the V-belts fairly loose. Tighten them just enough that they will not slip when the grinding wheel is pulling a full load.

Adjusting the Headstock Spindle Drive Belts. The headstock spindle is driven by four V-belts from a secondary drive shaft in the headstock. These belts may be adjusted for stretch and wear in the following manner:

1. Loosen the lock nuts "H", back off screw "J" and remove screw "K" (Figure 32).

2. Unfasten the hinged cover at the left end of the headstock and swing it back, exposing the secondary drive shaft and motor pulleys.

3. Turn the drive shaft pulley until one of the holes "L", through the pulley, lines up with hole "M" in the cap.

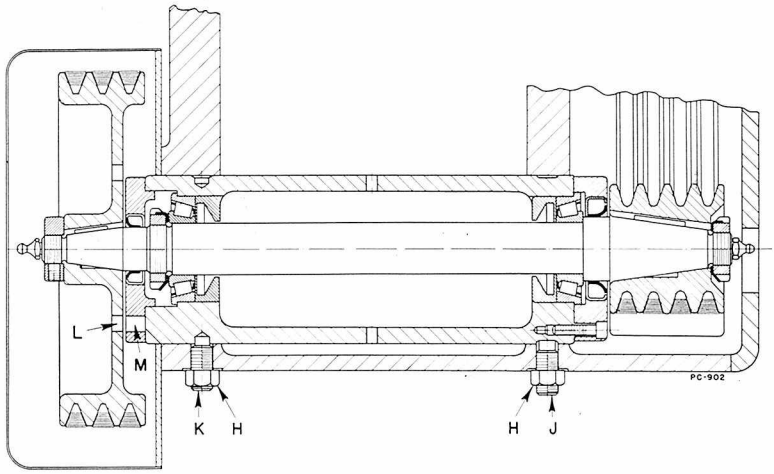

Figure 32
Section Showing Headstock
Spindle Drive Adjustment

4. Insert a rod through both of these holes and turn the pulley counter-clockwise, thus turning the eccentric barrel which holds the secondary drive shaft. Turn the pulley until the V-belts on the other end of the shaft are tight enough to carry a full load without slipping.

5. Lock the eccentric barrel in position with the set screws "J" and "K", making sure that "K" lines up with a hole in the barrel.

6. Remove rod and replace hinged cover on left end of headstock.

Adjusting the Headstock Motor Drive Belts. The V-belts which connect the headstock motor and the secondary drive shaft may be adjusted simply by loosening the four nuts on the T-bolts which hold the motor on the headstock and pushing the motor forward or backward to obtain the desired tension. It is best to adjust the belts just loose enough that you can feel a slight spring when pressing on them by hand.

Adjusting the Grinding Wheel Spindle End Thrust. The spindle is held against the end thrust by spring tension. Under an ordinary pressure of the hand on either end of the spindle no end play should be noticed. However, by applying leverage on the right end of the spindle you will find a slight movement. To actually test for end play, place a small steel ball in the spindle center and indicate against the ball with a 1/10,000 indicator while the spindle is running. The ball may be held in place with heavy grease or any adhesive material. Should you find free end play in the spindle in excess of .0001", adjust in the following manner:

1. Drain the oil from the spindle bearing compartment by loosening screw "C" (Figure 31) four or five turns. The ball that is held in place by this screw is allowed to retract and the oil to drain back into the reservoir.

2. Remove the circular cover from the front of the wheelhead, exposing the slotted end thrust adjusting nut.

3. Remove the socket head screw and lock shoe which lock the adjusting nut in place.

4. The adjusting nut has right hand threads. Turn it to the right with a face spanner wrench until it is tight, then back off 1½ slots.

5. Lock the adjusting nut in position with the shoe and screw provided.

6. Replace the circular cover on the front of the housing and tighten screw "C".

Adjusting the Grinding Wheel Spindle Bearings. An unsatisfactory finish may be the result of any one of a number of causes (see page 43) but rarely is it the result of the spindle bearings being out of adjustment, because they are designed to adapt themselves to a wide range of working conditions. However, if the bearings need adjusting, proceed in the following manner:

1. Run the spindle until the bearings are warm and continue to run while the adjustment is being made.

2. Relieve the tension of the drive belts slightly (see page 44). This step is advisable because tight belts may pull the spindle out of alignment with the bearings while making the adjustment.

3. Remove six oil plugs "A" at 1, 2, 3, 4, 5 and 6 (Figures 33 and 34).

4. The method of adjustment from this point on varies depending upon whether the machine is a new or old model. The old model is adjusted, as in the lower section in Figure 33, by loosening screw "E" and adjusting the screw "F". The new model is adjusted, as in the upper section in Figure 33, by removing screws "B" and "C" and then adjusting screw "D".

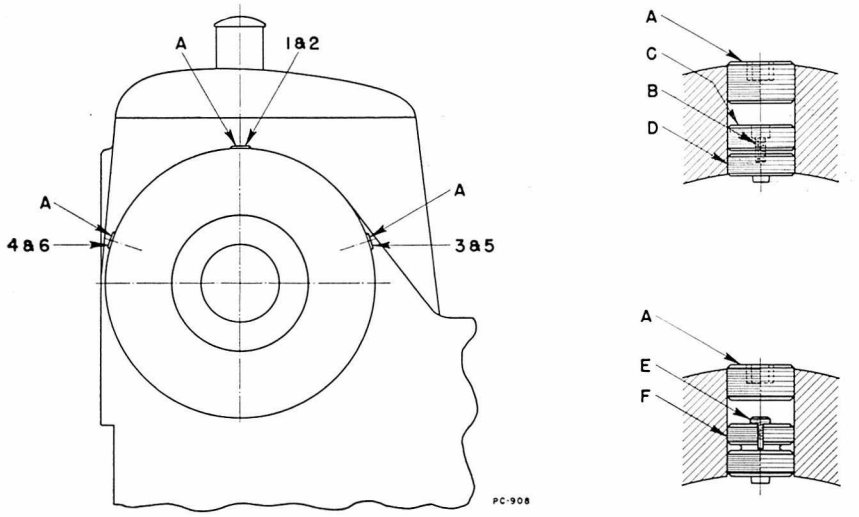

Figure 33
Grinding Wheel Spindle
Bearing Adjusting Screws

5. Adjust the six screws "D" or "F", as the case may be, in the order (1 and 2) simultaneously, (5 and 6) simultaneously), and (3 and 4) simultaneously (Figure 34). This order of adjustment must be adhered to. A snug adjustment of the screws is sufficient; do not apply too much force.
6. Replace the locking screws and oil plugs, being sure you do not alter the bearing adjustment. On the new model allow 1/32" to 1/16" clearance between "C" and "D" before locking.
7. Re-adjust the tension on the drive belts.

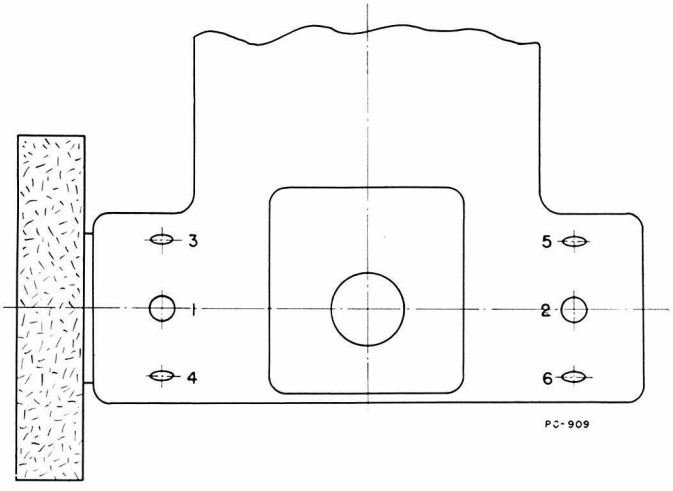

Figure 34
Top View Showing Spindle Adjustments

Adjusting the Hydraulic Oil Pressure. Should the table traverse lag noticeably or become irregular, there are several points which should be checked before concluding that the hydraulic oil pressure needs adjusting. Check to see if the specified oil is being used in the hydraulic system and that there is the required amount in the reservoir. Run the table through several long strokes to be sure there is no air in the hydraulic system. Examine the hydraulic oil filter, it may need replacing. Inspect the table ways to be sure they are not dry or gummy. Check the piping for leaks. After exhausting these possible causes of irregular table movement, then test the hydraulic oil pressure and re-adjust it if necessary.

In order to test the pressure and make the necessary adjustments, the various knobs, the table directional control lever and the starting lever must be removed from the central control panel on the front of the machine and then the cover may be removed, revealing the hydraulic control unit.

The unit will appear as in Figure 35 with the cover removed. Remove the pipe plug "A" and attach a pressure gage at this point. Then start the machine and observe the pressure reading while the table is stationary. This pressure should be about 250 pounds per square inch. If it is appreciably more or less, loosen the lock nut and adjust screw "B" until the pressure is correctly set.

Replace all of the parts which were removed, being careful that the starting lever shaft and the table directional control shaft are properly set to receive the cover. The pin "C" in the starting lever shaft must be in a vertical position and the central portion of coupling "D" on the table directional control shaft must be in a position to receive the upper portion of the coupling after the cover is in position.

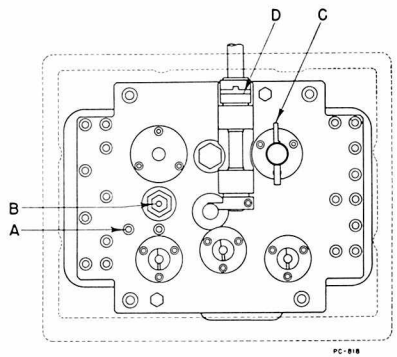

Figure 35
Hydraulic Control Unit

The hydraulic oil relief valve, which protects the oil filter (Figure 13), has been properly set at the factory and its setting should not be altered in an attempt to correct the pressure in the hydraulic system.

Adjusting the Volume of Oil to the Ways. Four valves in the distributor control the volume of oil to the table and wheelhead ways. They are accessible when the cover at the left rear of the machine is removed. The valves control the oil to the various ways as indicated in Figure 13. Turning the valves counter-clockwise increases the flow of oil.

When starting the machine for the first time or after it has been idle for several days, allow the lubricating oil pump to run for several minutes before moving the table, to be sure that oil is being pumped to the ways. If oil is not reaching the ways, it will be necessary to prime the pump. This may be done by disconnecting the tubing that leads to the left end of the lubricating oil filter and pouring oil into the line at this point.

An adjustment of from ¼ to ½ a turn counter-clockwise from the closed position is usually sufficient for each of the four valves. It is advisable to have the table in motion while adjusting the flow of oil to the table. With the aid of a flashlight, the amount can be observed through the covered peep holes in the telescopic guards, after the table has traversed a few strokes.

Adjusting the Footstock. Normally the footstock does not require adjustment. However, if conditions indicate that it is necessary, proceed in the following manner:

1. Make sure that the spindle and barrel are free of dirt and grit.
2. Remove four screws "A" (Figure 36) and tighten spreader screws "C".
3. Pry out the filler block. Surface grind one side of it, removing only a very small amount (not exceeding .0003").
4. Replace the filler block, release spreader screws "C", and replace screws "A".
5. Try the spindle. If still too much "play", repeat the above procedure.
6. For best results, lap the spindle in its housing.

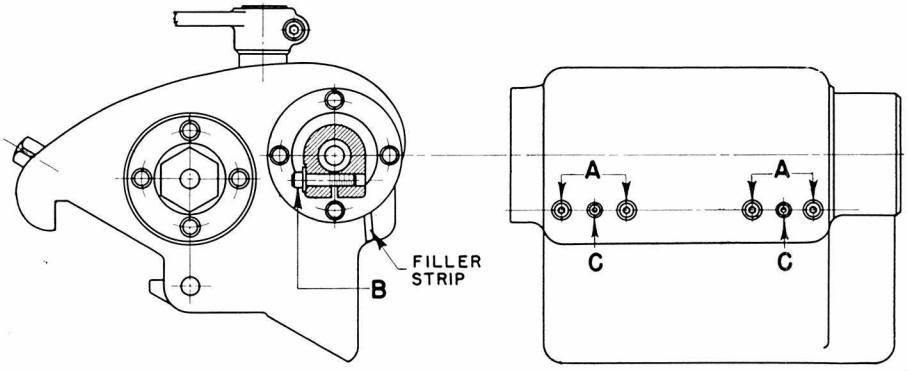

Figure 36
Footstock Spindle Adjustment "B" is a Lock Screw for Handwheel Advance and Retraction of Center

What to Do When Oil Does Not Appear in Glass Reservoir Above Grinding Wheel Spindle. If the grinding wheel spindle starts and runs satisfactorily but oil does not appear in the cylindrical glass reservoir on top of the cap above the bearing compartment, the air bleed hole in the cap has become clogged. This condition should be immediately corrected in the following manner:

1. Stop the oil pump motor.
2. Remove screw "A", cap "B" and glass "C" (Figure 37).
3. Lift up loose plate "D".
4. With a wire 1/16" or less in diameter, clean out bleed hole "E".
5. Replace the parts, including the gaskets (one under the head of screw "A" and one each at the top and bottom of glass "C").

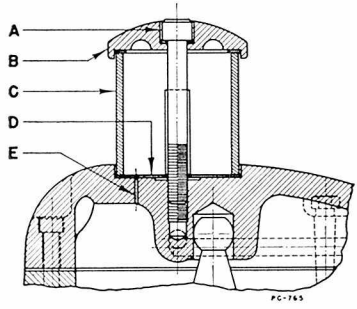

Figure 37
Section Through Spindle Cap and Glass Reservoir

Instructions for Changing Sheaves. Extra sheaves are supplied for increasing the grinding wheel speed after the wheel has worn down to a predetermined diameter. The design calls for the sheaves to be changed as listed below:

Starting with 30″ diameter wheel, change at 26″ diameter wheel.
Starting with 24″ diameter wheel, change at 19″ diameter wheel.

The safety device has been provided to insure that the correct sheave is used with new or worn wheels. Notice a rod "A", which extends through the wheelhead casting about midway between the spindle and its driving motor but below the level of the spindle axis, as in Figure 38. The left end of this rod extends through a hole into the wheel guard. To the right end of the rod is attached a spool "B".

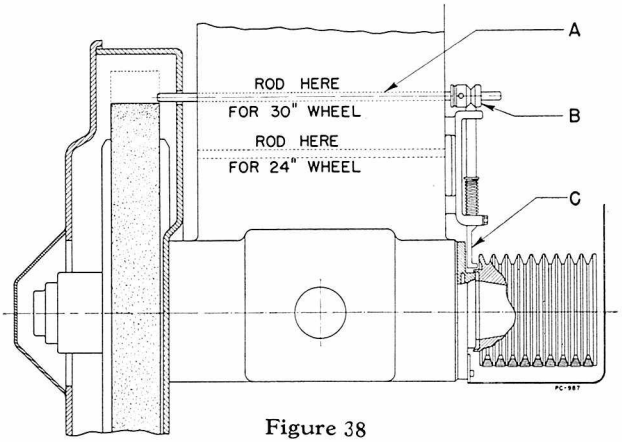

Figure 38
Grinding Wheel Speed Safety Device

In order to put a new (large) wheel on the spindle nose, the rod "A" must be moved to the right. As "A" is moved to the right, spool "B" forces the safety rod stop "C" towards the flange on the rear of the sheave. And so stop "C" will not permit "A" to be moved to the right unless the small (high-speed) sheave, which has the flange on the back, has been removed. Only the large sheave may be mounted on the spindle when the safety device is shifted to the right. Then, as the grinding wheel wears down to the size at which the sheave should be changed, the device may be shifted to the left, as shown in Figure 38, so that rod "A" extends into the wheel guard and stop "C" is in its "up" position. The small, high-speed sheave may then be put on the spindle. Rod "A" is used interchangeably in the two tubes through the wheel head, to accommodate either the 24″ or 30″ wheel.

EXTRA EQUIPMENT

Not Included With Standard (Basic) Machine

Hand Servo Infeed Attachment. This hydraulically operated attachment is used for hand plunge cut grinding. When control lever "A" (Figure 39) is moved clockwise from its "up" position through an arc of approximately 97° to its "down" position, the wheel head moves towards the work piece about one inch. The first 13° of lever motion moves the wheel head .990″, while the last 84° of motion moves the wheel .010″, thus facilitating rapid approach and grinding feed rate. During the first 13° of clockwise movement of the lever, the headstock and coolant pump motors are automatically started. Of course, the buttons on the electrical control panel must be correctly set for this. The servo infeed is supplemented by the infeed hand wheel when setting up and compensating for wheel wear.

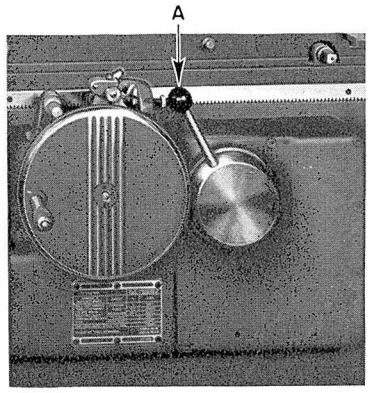

Figure 39
Front View Showing
Hand Servo Infeed Attachment

Power table traverse is inoperative unless the infeed lever is in its "down" position. To prevent the wheel head from surging towards the table when the hydraulic drive motor is started, the infeed lever should be in the normal "down" position before the machine is stopped for the day.

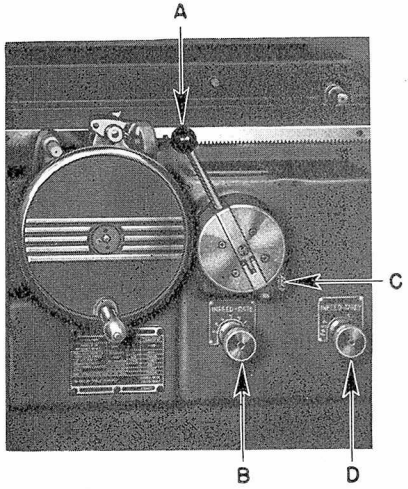

Figure 40
Automatic Infeed Attachment

Automatic Infeed Attachment. This hydraulically operated attachment is used for automatic plunge cut grinding. With the exception of a slight hand start of the control lever "A" (Figure 40), the attachment completely controls the grinding cycle for infeed work. The movement of the control lever starts and stops the work rotation and coolant flow in the same manner as the hand hydraulic infeed lever. In addition, it also controls the advance and retraction of the footstock center when the machine is equipped with an hydraulically operated footstock.

Knob "B" controls the infeed rate of the wheel head. Knob "D" controls the period of tarry while the wheel head is at its innermost position, to permit "sparking out" of the work. A cam within the unit determines the ratio of the distance moved in rapid traverse to the distance moved at a feed rate. The ratio may be altered by removing the cover from the top of the unit and adjusting the cam to the right or left by means of the set screws. Adjust to the right to decrease the length of stroke at a feed rate, or to the left to increase the length of stroke at a feed rate. After adjusting the cam, lock it in position with the cam screw. The cam rise corresponds directly to the infeed motion of the wheel head. A certain variation above and below the given cam rise is obtainable, if the particular job demands it, by adjusting the cam with which the machine is equipped toward or away from the hub.

To obtain a longer rapid infeed stroke without re-adjustment of the cam, pull forward lever "A" and push it to the right until it contacts a stop which is controlled by knob "C". Then release the lever and the remainder of the infeed cycle will continue automatically. Knob "C" moves the stop

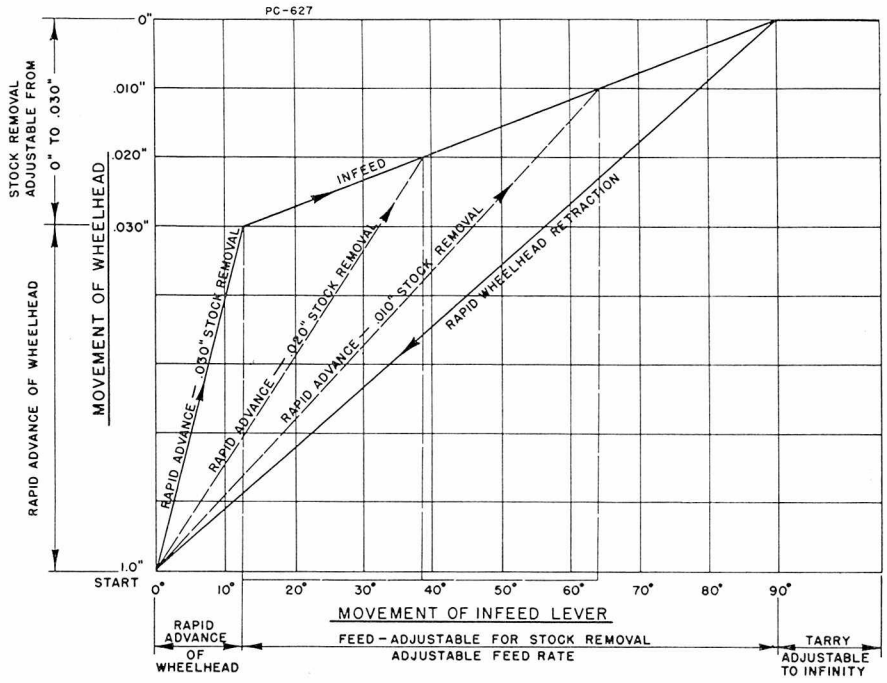

Figure 41
Graph—Showing Movement of the Automatic Infeed Attachment Lever and Wheel Head

up or down to regulate for different amounts of stock removal. A graphic presentation of this description of the relative motions of the wheel head and infeed lever are shown in Figure 41.

When traverse grinding, place the infeed lever in its "down" position and turn the infeed tarry control "D" to the extreme right, thus preventing the infeed cycle from being completed. The table movement is stopped and the wheel head is retracted, bringing the infeed lever into starting position, by merely shifting the table traverse "Start-Stop" lever about 30° to the right of its normal stop position.

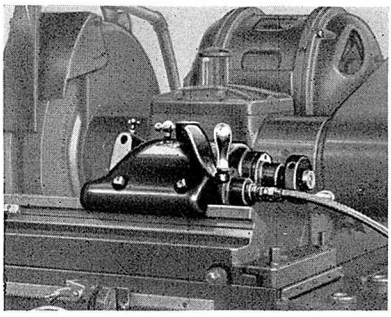

Figure 42
Hydraulic Footstock

Hydraulic Footstock. The hydraulically operated footstock is arranged for automatic advance and retraction of the footstock spindle and center when infeed grinding with the Hand Servo Infeed or Automatic Infeed Attachments (Figure 42). The action of the footstock is controlled by the movement of the infeed lever. However, the footstock may also be hand operated by disconnecting and plugging the hydraulic pressure line to the footstock.

When setting up for any type of grinding job, and at all times during traverse grinding, it is advisable to use the hand control of the footstock. Do not use the automatic footstock control unless cradles are used. These cradles support the work, prior to engaging the headstock and footstock centers, approximately in line with the centers (Figure 43). The cradles are necessary so that the operator may remove his hand before the infeed movement starts. Try out the automatic set-up without inserting the work until you are entirely familiar with the sequence of movements—tailstock center engagement, work rotation, coolant flow and infeed.

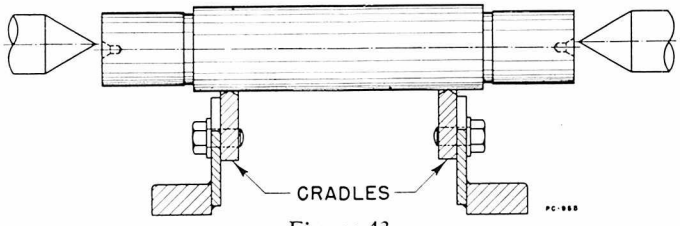

Figure 43
Loading Cradles

Back Rests. Two types of back rests are available: the screw type (Figure 44), which has a capacity of ½" to 4½", and the spring type, which has a capacity of ¼" to 2". Although the number of back rests to be used is entirely dependent upon the nature of the work, we recommend one for the 18" length machine, three for 36", four for 48", five for 72", and six for 96".

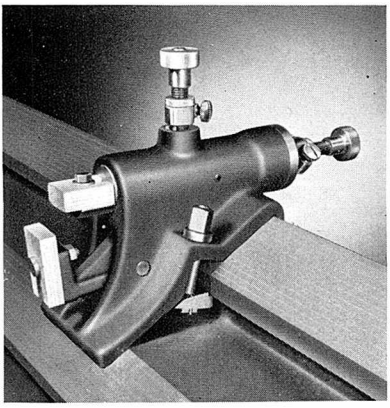

Figure 44

Reciprocating Attachment. This attachment produces a finer finish on plunge cut work, all other conditions being equal. The spindle reciprocation is hydraulically produced and the spindle is locked in position when reciprocation is not needed. The "start-stop" lever on the right-hand side of the top of the unit (Figure 45) controls the reciprocation, while the dial on the left-hand side controls the length of stroke, which may be regulated from $\frac{1}{32}$" to $\frac{3}{16}$".

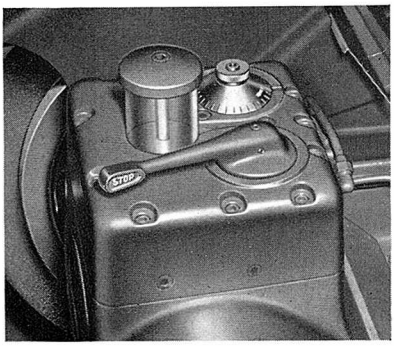

Figure 45

Balancing Stand. Enables the operator to obtain perfect static balance of wheel mounts, resulting in smoother finishes, higher production, longevity of wheel and diamond and safer operation (Figure 46). Revolving discs on stand made of chilled iron rotate on ball bearings. Spindle and bushings hardened. Size No. 2. Capacity: 40" swing, 30" between uprights. For instructions to use balancing stand, see page 29.

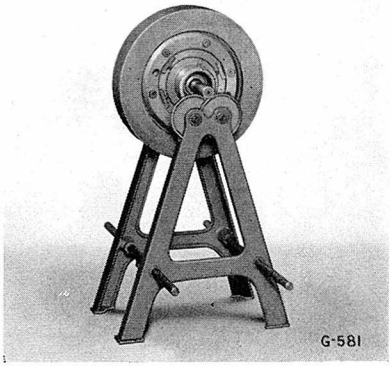

Figure 46

Balancing Arbor for Grinding Wheel—Size No. 2 (Part No. 221837).

Wheel Mounts. The standard balancing type wheel mount which is supplied with this machine is for a wheel of 30″ diameter x 20″ hole x 3″ face. Balancing type wheel mounts are available for other sizes of wheels, within limitations, as listed below:

30″ diameter x 20″ hole x 2″ face
30″ diameter x 20″ hole x 4″ face
24″ diameter x 12″ hole x 2″ face
24″ diameter x 12″ hole x 3″ face
24″ diameter x 12″ hole x 4″ face
24″ diameter x 12″ hole x 5″ face
24″ diameter x 12″ hole x 6″ face
30″ diameter x 12″ hole x 2″ face
30″ diameter x 12″ hole x 3″ face
30″ diameter x 12″ hole x 4″ face

Multiple Wheel Mount Spacing Collars.

Wheel Guards of suitable sizes are available for any of the grinding wheels listed above.

Center Grinding Fixture—60 degree power operated.

Angular Wheel Truing Attachment—Table type, includes diamond holder, but not diamond or nib.

Radius Truing Attachment—Table type, 0″ to ¾″ convex or ⅜″ to ⅞″ concave. Includes diamond holder, but not diamond or nib.

Headstock—Live spindle.

Cam Grinding Attachment—Replaces regular footstock; driven by headstock.

Diamond Bracket—Table type.

Half Centers for Footstock.

ORDERING REPLACEMENT PARTS

Prompt service on replacement parts will be given you upon receipt of the correct information. We must have the following data:

1. **Amount wanted.**
2. **Part number stamped on part.** (If part number has been worn off, send us a sketch of the part.)
3. **Name of machine** (Plain Hydraulic Grinding Machine—Model ER).
4. **Serial number of machine.**

The serial number is absolutely necessary. It is stamped on the front of the base on the right end just below the telescoping guard and also on the headstock and footstock.

Listed below are the commercial items which you may find necessary to replace:

Spindle Drive V-Belts. Consists of nine V-belts, matched for length. Vulco-Gates 68-B, our part number 78824, pitch length 69.5 inches.

Headstock Motor Drive V-Belts. Consists of 3 V-belts, matched for length. Motors with frames 224 or 225 require Gilmer V-Belt No. 3390, our part number 232754, pitch length 38 inches. Motors with frame 204 require Gilmer V-belt No. 3400, our part number 232753, pitch length 39 inches.

Headstock Spindle Drive V-Belts. (Inside Drive). Consists of four V-belts, matched for length. Gilmer V-belt, same as No. 3 A 5 except all neoprene, our part number 232714, pitch length 36 inches.

Oil Filters. Hydraulic oil filter — Motor Improvements, Inc., type EA ½ W, ½" pipe thread inlet and outlet, our part number 225470. Table way lubricating oil filter—Motor Improvements, Inc., type L-1200, ¼" pipe thread inlet and outlet, our part number 219666.

Grinding Wheels. 30″ diameter x 3″ face x 20″ hole. A separate wheel mount is recommended for each grinding wheel regularly used. The parts required for a complete unit are:

One wheel collet—part number 235381
One flange—part number 235380
One key—part number 3446
Four balancing weights—part number 81608
Four screws—part number 81607
Eight screws—part number 3268
One pin—part number 1382

MEMORANDUM

DIRECT FIELD ENGINEERING OFFICES

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CHICAGO 12, ILLINOIS
2400 West Madison St.

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CLEVELAND 3, OHIO
4614 Prospect Ave.

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NEW YORK 17, NEW YORK
155 East 44th St.

PITTSBURGH 22, PENNSYLVANIA
1207 Empire Bldg.

SYRACUSE 2, NEW YORK
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WASHINGTON 5, D. C.
15th and New York Avenue

WEST HARTFORD 7, CONNECTICUT
10 North Main St.

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Chandler Machinery Co., 120 Houston St. N. E.

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C. A. Thumm, 1800 N. Charles St.

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